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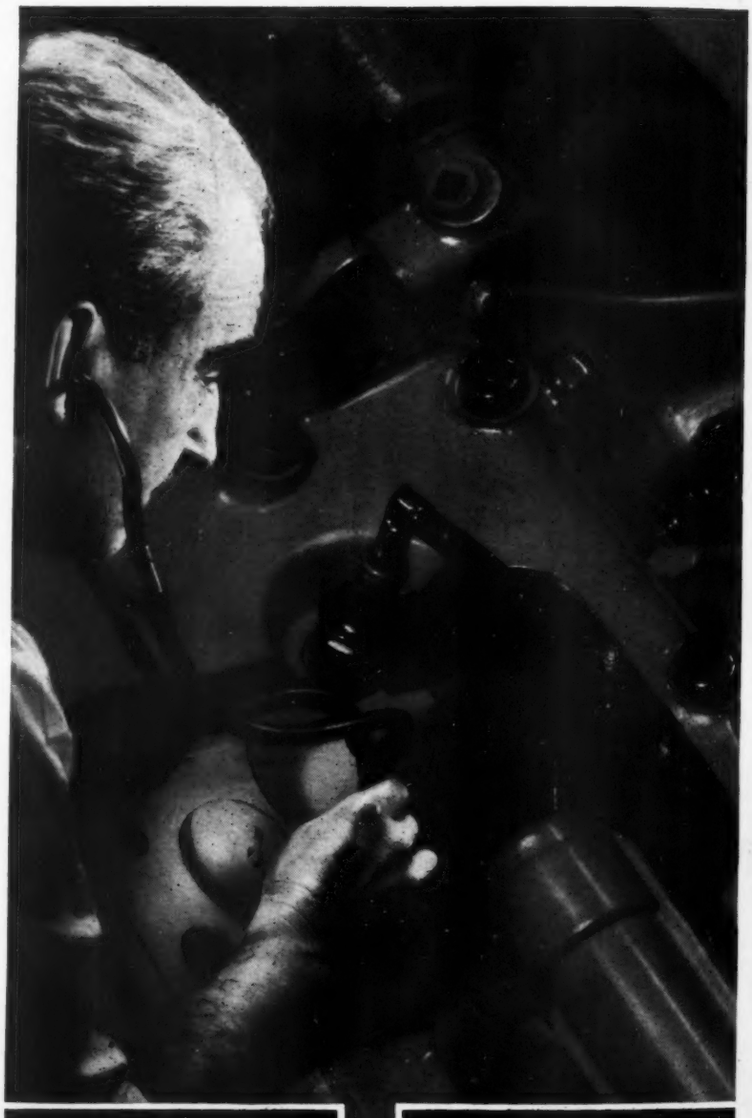
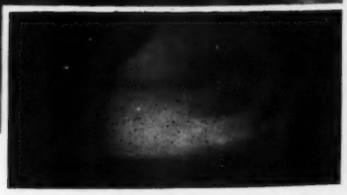


LOOK INSIDE THE CYLINDER! Through a quartz window in the cylinder head of a modern high compression motor, Detroit engineers took this photograph of the uneven, wasteful explosion of ordinary gasoline. That white-hot line is *knock*.



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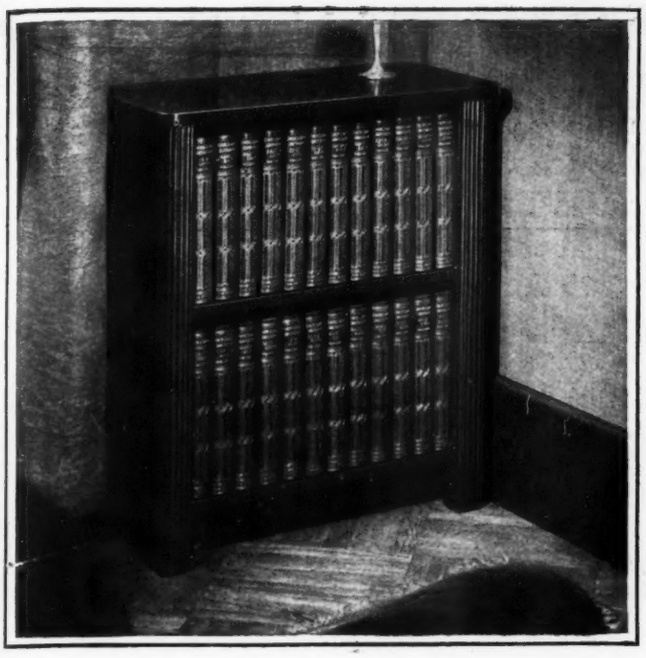

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POPULAR SCIENCE

FOUNDED MONTHLY 1872

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From the Counting Stones of the Romans

Came Our Word

CALCULATE

The ancient Romans had no adding machines. Few could even read or write. So their counting and reckoning was done with the aid of little stones used as counters. The Latin word for the pebble used in this way was **calculus,** derived from **calx** meaning "limestone." From **calculus** was developed the verb **calculare,** "to calculate," and this is the immediate origin of our word **calculate.**

The branch of mathematics which we call **calculus** was named directly from the little counting stone of ancient Rome.

Every day you use hundreds of words whose origins are as interesting and surprising as this. You will find their fascinating stories in

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BROKER

Originally a Vender of Wine

The modern broker who engages in large-scale financial operations takes his name from a humble origin. **Broker** is derived from the old French **broquier** or **brokier,** a dialectal form of **brochier,** "one who taps a cask in order to draw the liquor." Thus, the **broker** was in the first place a retail vender of wine.

NEIGHBOR

Once Meant a Near-by Farmer

In Anglo-Saxon **neah** meant "nigh," "near," and **gebur** meant "dweller," "farmer." These two words were combined into **neahgebur,** meaning, literally, "a near-by farmer." The word appears in modern English as **neighbor,** with a meaning that has changed with the evolution of civilization.

The coupon below will bring you free an illustrated booklet of word-origin stories. Not only do these stories make the most interesting reading, but to know them will give you an effectiveness in speaking and writing that can come in no other way. When you know where our words came from, and their essential meanings, as they are presented in The Merriam-Webster, your own use of words will become more forceful, accurate, and colorful.

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In This Issue—Hundreds of Articles and Pictures Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

HOW TO GET PARTS FOR MAKING A BEAUTIFUL GALLEON MODEL

Whether you have ever built a ship model or not, here is your chance to make one of the most decorative and colorful little vessels ever designed—the POPULAR SCIENCE MONTHLY Spanish Galleon. Complete kits of selected materials have been prepared under the supervision of the Popular Science Homecraft Guild for distribution at the specially low price of $6.45 each.

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You will find an illustration of the model on page 90 of this issue. Thousands of readers have already built it successfully; in fact, it has been by far our most popular ship model. Heretofore, however, everyone has had to spend hours shopping for the necessary materials, some of which are hard to obtain even in the larger cities, and the cost, naturally, has been high. A coupon is given below, but if you do not wish to cut the magazine, you may order by writing a separate letter.

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Smoker calls it "Only blend I never tire of"

MANY a pipe smoker spends years in his search for the "perfect" tobacco. Once discovered, however, will that tobacco remain uniformly the same, package after package, year after year? That is what every pipe smoker wants to know, and that is why it is good news when R. K. Wheeler of Dayton, Ohio, writes that in 16 years "I have never purchased a single package of Edgeworth whose flavor and aroma differed in the least from another." His complete letter will interest smokers.

1017 Shakespere Ave.
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March 4, 1932

Larus & Bro. Co.,
Richmond, Va.

Gentlemen:

I have noticed for some time the various letters published by you from users of Edgeworth, and I felt impelled to add my "nickel's worth" to the chorus of praise.

I have used Edgeworth exclusively for sixteen years, and the only reason that figure is not larger is that I did not discover Edgeworth sooner.

I have tried many of the different pipe tobaccos on the market, but Edgeworth is the only tobacco I can smoke day after day without tiring of its flavor. Where do you get it? How do you do it? In all these years I have never purchased a single package of Edgeworth whose flavor and aroma differed in the least from another.

So I too say, "Keep up the good work," for it would be a sad day for pipe smokers should Edgeworth disappear from the tobacco shops.

Yours truly,
R. K. Wheeler

Edgeworth has confirmed thousands in their belief that smoking holds no pleasures equal to the satisfaction of a good pipe and good tobacco.

Would you like to try this Edgeworth blend? Then send your name and address to Larus & Bro. Co., 110 S. 22d St., Richmond, Va., for a free sample packet of Edgeworth. Or you can buy it in two forms—Edgeworth Ready-Rubbed and Edgeworth Plug Slice. All sizes from 15-cent pocket package to pound humidor tins. Several sizes also come in vacuum sealed tins.

Pipe smokers and their families will enjoy the Edgeworth Radio Program. Make it a point next Wednesday evening from 10 to 10:30 (E. S. T.) to listen to "The Corn Cob Pipe Club of Virginia." It is broadcast over a coast-to-coast network of the National Broadcasting Company.

IS MY *Insurance* SAFE?

By LEON MEADOW, *Financial Editor*

"LET the women play bridge. It's a darn sight cooler out here," said Jack Kennedy, tipping back his chair and putting his feet on the porch rail.

"You're right," came a voice from the dark, where the glow of a cigar was the only indication that someone was actually there. It was Ted Jackson. "And besides," he continued, "who can keep his mind on bridge these days? I can't—too much to think about."

Frank Quinn, quiet up till this point, joined the conversation. "Just thinking about it won't do you much good," he said.

"What's on your mind, Ted?" asked Kennedy.

"Well, here I've put in two years reconciling myself to changing conditions, adjusting myself to new standards and all that. Now I reach the point where I've decided I can account for the worst that may happen and am willing to take it as it comes. In other words, I'm ready to stand pat on what's gone before in the way of losses, and to start out anew. What happens? Several large life insurance companies start to cut their dividends. No matter how bad things have been, I've always believed that my life insurance would be safe—nothing could disturb that. Now, with these dividends cut, I'm beginning to worry about insurance too."

Jack Kennedy interrupted. "I don't know how much you have to worry about, Ted—but, if I were you, I wouldn't go out of my way to pick up additional worries. Anyway, I think I can erase this bugaboo for you without much trouble. Life insurance companies are safe. That is, of course, all reputable ones."

"YOU know more about these things than we do," put in Frank Quinn, "but I'm like Ted. I need more convincing. All I know is that insurance companies sink most of their income into securities and mortgages—and no matter how carefully or conservatively they've picked 'em, they must be in the hole, same as everybody else."

"Well boys," Kennedy answered, "I'm no financial wizard, but I think I do know enough about insurance companies to convince you of their safety. Do you want to be convinced?". Both men said they did, so Kennedy continued:

"I'll answer Frank first. That seems the best way to start. About 35% of all insurance companies' assets are in domestic stocks and bonds—mostly bonds—and about 2 or 3% in foreign securities. Almost 40% are in mortgages. On the face of it, then, it would seem that insurance companies have taken a pretty bad licking. But the peculiar part of it is that the ups and downs of the security and real estate markets have far less to do with the affairs of a life insurance company than most people think."

"How so, Jack?" interrupted Ted Jackson.

"I THINK the best way to prove that is by a simple comparison between an insurance company and a commercial bank. There's one tremendous difference, you know, between these two organizations, and that difference is one of the factors that make the insurance company so safe. Banks must keep their assets in a 'liquid' condition, because it is quite possible that at any given moment they will be called upon to pay out a great part, or even all, of their deposits. The sad experiences of the last two years have taught us how easily that can happen. Because of this condition, the state of the security and real estate market at any given time is of vital importance to a bank. If it's forced to liquidate in bad times, you have trouble—and plenty of it.

"On the other hand, the assets of an insurance company are not subject to such hazards. They never experience runs, panics or public hysteria. It's very simple. An insurance company writes a policy for a man—and on the average, its debt to him is not payable for fifteen or twenty years. A bank takes a deposit from a man, invests it, and the next day he turns up for his money. There's a vast difference there. The insurance company does not depend on market fluctuations because its assets do not have to be liquidated on short notice. Investments made by insurance companies are long-term affairs, bearing definite interest till a definite maturity date. Fluctuations between the dates of purchase and maturity don't mean anything. Even the law recognizes this and allows the life insurance companies to value their bonds on an amortization basis —which means at a value *consistent with their purchase price.*"

"That's very true, Jack," Quinn said. "Hadn't thought about it from that angle

IS MY INSURANCE SAFE?

(Continued from page 6)

before. But insurance companies must sustain some losses in income in times like these. I mean stock dividends have been cut tremendously and there have been so many defaults on bonds and mortgages."

"Right enough," Kennedy replied, "there has been some decrease in interest earnings, and this is the chief reason for these dividend cuts. But do you know that if every cent of income from investments in stocks and bonds and mortgages had been cut off in 1931, insurance companies would still have had enough coming in in premiums to pay out all demands for the year? The other day I was talking to a man representing a fairly large company. He showed me the balance sheet for 1931. Company took in $36,000,000 in premiums and paid out something like $24,000,000 in matured policies, in face value on deaths—and in policy loans. And what's more, that last item of policy loans can't really be considered as money paid out—but as an investment—and certainly the safest of them all."

"HOW do you make that out?" asked Jackson.

"Like this, Ted—a man borrows on the full loan value of his policy. If he pays his 6% interest—well and good. If he doesn't pay it, the charge is automatically deducted from the remaining equity in the policy. If he never pays it—the final reckoning comes at the time of his death, when it will be found that, sadly enough, there is a difference between what his beneficiary should get—and does get."

"I give in," interrupted Frank, with a short laugh. "That certainly seems to be enough of a safety factor for any one."

"It should be," answered Kennedy, pausing to light a cigarette. "But in case it isn't," he continued, "there are still a number of other factors that combine to make your insurance even safer. Let's go back to the remark which started this whole discussion—dividend cuts. If an insurance company should cut out their dividend entirely for one year, they could conserve about 15% of their premium income. Think that over for a minute. It means that even if their investments go sour, even if their policy lapses are tremendous and even if they must pay out an unusually large amount on death claims or matured policies, there is still this way of conserving their income. For what purpose? To preserve their guarantee to you—in event of your death—to pay the full amount of your policy. Wouldn't you take a dividend cut to insure that? Good Lord," he added vehemently, "how many people in this country would gladly have accepted dividend cuts on their stock investments—if it meant protecting the face value of them? How many people have taken dividend cuts and still lost every cent they put into them?"

The men remained silent for a few minutes; each was absorbed in his own thoughts. Then Frank Quinn said, "Talking about death claims and matured policies, have *(Continued on page 8)*

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IS MY INSURANCE SAFE?

(Continued from page 7)

insurance companies any way of telling or judging approximately how much they will have to pay out in a year?"

"Yes, they have," replied Kennedy. "They can forecast these things with close approximation by means of their mortality tables. Incidentally, that brings up another safety factor in favor of life insurance companies. In this country the death rate for the public at large is higher than that of life insurance policy holders. One reason for this is the medical selection and acceptance of people who are likely to have long lives. The unfit are rejected. Consequently the actual number of death claims on which a company pays out during a year runs lower than their expected mortality, according to the tables. And the rates, you know, are governed by these tables. This means an annual savings to policy holders—and part of it is returned in dividends, the rest being invested in surplus."

"You certainly are piling up evidence for your case, Jack," Ted Jackson said. "I'm beginning to feel much safer about the situation. Anything else you add will just about clinch the argument."

"Well," his host replied, with a smile, "I haven't finished yet—if that's what you mean! Another safety factor with life insurance companies is their practice of using a conservative rate of interest in their premium calculations. Although they have for years earned about 5%, they have used only 3 or 3½%.

"NOW, let's return to this question of capital investment. Certainly the depression has hit the investments of insurance companies, as well as every one else's. About 10% of their money is in farm mortgages. The farmer has been hit hard. Yet, I have seen figures showing that 75% of these mortgages, even today, are returning interest payments. Insurance companies rarely loan on more than 50% of the appraised value of property. So, even if they have to foreclose on 20 or 25% of farm property mortgages—the equity is certainly large enough to make those frozen assets worthwhile to the company when they thaw out in good times. The best part about it, as I said before, is that they don't have to liquidate. Insurance companies can sit tight in bad times—and wait for better days. As far as other mortgages are concerned, the great majority of them are in personal homes—and not in office buildings and hotels, where rental incomes have been badly reduced. So that the same condition holds true for this type of mortgage.

"All right, Jack, but what's happened to their bond holdings?" asked Frank Quinn.

"I was coming to that," Kennedy replied. "About one fifth of them are in U. S., Canadian, Municipal and other Government Bonds. Insurance Companies have invested comparatively little in bonds of other foreign countries. The greatest part of the remainder are in railroad and utility issues. But that's not as much cause for alarm as you *(Continued on page 9)*

IS MY INSURANCE SAFE?

(Continued from page 8)

would think. In the case of railroads, insurance company holdings are comprised mostly of underlying issues or virtual mortgages on main routes of travel—ones that would suffer but little, even in the event of receivership. Practically the same thing is true of their public utility holdings which are not the ordinary run of bonds of holding companies, but are actually liens on power plants and companies.

"All these investments, regardless of market prices, are essentially and fundamentally sound, gilt-edge holdings. They will come back to par. And since insurance companies can hold on and do not have to liquidate, their assets are practically 100% safe."

At this point Jack's wife, Martha, stuck her head out of the porch door and made a poor attempt to glare at the men. "Are you fellows going to continue settling the nation's affairs," she said, "or are you going to be sensible enough to come in and have some refreshments while they last? I've been calling you for the last five minutes."

"Coming now, Martha," Jack answered. The men got up, and, as they were going inside, Kennedy added, "By way of final proof, stick this in your pipes and smoke it: In the last fifty years, no reputable and important life insurance company in the United States has failed."

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worth-while investment as well as a form of protection. Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate Plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

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Our Readers Say

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Glass Goblet, Not Ear Drum, Shattered by Singer

IT HAS been said that Caruso would sing into a glass goblet, the tone which the goblet possessed and the goblet would fall to pieces. Dr. Abrams believed that he could change the conditions of diseased tissue by applying to the tissue a rate of vibration similar to that of the tissue affected. Recently Dr. Leslie A. Chambers and Prof. Newton Gains of Texas Christian University, perfected an apparatus that would kill eighty percent of all bacteria present in samples of milk. In putting different mixtures of potenized medicine into a glass goblet I have had the experience of having them fall to pieces on the table. The reason is probably because the native vibration of the mass, due to the constant movement of the atoms within it, produce an individual set of emanations that travel on their own plane. When a forced set of similar vibrations meet the mass vibrations there is an explosion.—C.E.M., Seattle, Wash.

Nudist Colonies Might Gain Another Good Member

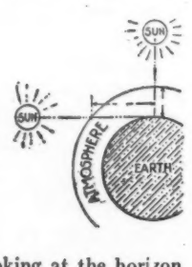
AS TO J.W.L.'s contention that the artificial production of diamonds will not prove of commercial value, we will not argue. One thing that appears obvious, however, is that J.W.L. does not appreciate what science and scientific research have produced. Might I suggest that he go about his daily routine without using anything produced by science. Soon, I am sure, he will change his mind and be glad to wear comfortable clothes, ride to work in a car, and sleep in a soft bed at night. And eat something properly cooked.—R.W.M., Harrisburg, Pa.

Magazine, Not Newspaper, Wanted by This Reader

I HAVE been a very ardent reader of your magazine since 1924 and this is the first suggestion I have to make. Let us have a few more pages devoted to radio circuits and diagrams. After reading "Our Readers Say," I have this answer to make to C.E.G. of S. Fernando, Argentina, regarding the paragraph asking for "World Finance News" and "Higher Education in U. S." Anyone desiring such reading material, is reading the wrong magazine. This is a mechanical and industrial magazine. *Don't turn this popular magazine into a newspaper.*—K.B., St. Paul, Minn.

Pertinent Facts to Oust Fanciful Astronomy

I SHOULD like to take up a little space in reply to the letter of J.V.L. of Evansville, Ind. If for any reason the star A, which is one light year distant from the earth, were obliterated we would not know it until one year after the occurrence. The fact that it is one light year distant states that it takes light one year to reach us from the star. As a matter of fact, the nearest star is some six light years distant. Light does not travel instantaneously. Its velocity in air is 186,285 miles per second as determined by Michelson in 1924 at Mt. Wilson, California, with an error of not more than ten miles per second. As to the absence of stars at the horizon proving the vacuum, that is all bunk. The greatly decreased number of stars at the horizon is due mainly to the fact that the clouds and dust in our atmosphere obscure them. Looking at the horizon one looks through the thickest and densest part of our atmosphere and there are invariably clouds and dust present. If one were to look at the sky in the late fall, one would see the Milky Way very near the horizon in the East and it will extend below the horizon at about the North and South points. Where then does the statement that "the absence of stars at the horizon serves to prove that space is a vacuum" come in? If J.V.L. would like to know a little more about the stars, I would refer him to "A Beginners Star Book," by McKready.—H.A.R., Coleman, Can.



Ice to Water Question Brings This Answer

W.M.G., Port Washington, N. Y. asked about ice and water at zero, Centigrade. It requires eighty calories of heat to change one gram of ice at zero to one gram of water at zero C. So if you have one gram of water at 0° C. you must take away eighty calories of heat to change it to ice at 0° C. and vice versa. Since you add or subtract heat it is not perpetual motion. Can anyone tell me what a photon is? It is something that has never been found in parts. It is always whole. Dr. R. A. Millikan says that it is proof that matter is building up in outer space. Now then what is it? I should also like to know where your artist found the five legged microbe he pictured. His pictures are all right, but I wish he would be accurate.—R.R.F., Noble, Pa.

Flying Chinamen Just Flapped Their Wings

THERE'S an old, old legend, or something, to the effect that centuries ago the Chinese flew on flapping, man-powered wings. The report doesn't say they ever got very high or very far and it makes no mention of what happened to the flyers. Plenty, most likely. Now you tell us sea gulls are going to give men the secret of flight on personal wings. Oh, yeah? The condor is quite a bird, with a wing spread enormous in proportion to its weight. Take a human bird and give him a wing spread in the same proportion and then figure out the muscular development necessary to run those wings and you'll get something. Why not talk sense once in a while and admit that man is a machine-using monkey and pitiful when robbed of all artificial means of attack and defense?—L.D.T., Larchmont, N. Y.

Our Knockers Give This Florida Reader a Pain

I AM a steady reader of POPULAR SCIENCE MONTHLY and I think there is no other magazine like it. I agree with W.T.C. of Muskogee, Okla., knockers give me a pain. I have all my copies of POPULAR SCIENCE in my wardrobe. The covers are wearing out because I look at them so often. I have a hard time waiting for the next one to come and when it does come my family won't hear a word from me until I have read it from cover to cover.—R.C.W., Jacksonville, Fla.

His Morning-Glories, Like Some People, Always Seek the Sun

I AM having trouble with my morning-glories. If I were a scientist, as many of "Our Readers" are, I could tell what is wrong. I tried to make them climb from the left side of the wire around to the right, and arranged them like that; but they unwound themselves immediately, so I tied one in that position, and it twisted itself in two, and put out a new tendril, and began to climb from the right side of the wire back around to the left. So I dug into

my botanical knowledge, and reasoned that they were following a natural law of pointing to the sun. "Our Readers" must tell me if I am right.—J.C.B., Pocasset, Okla.

Even The Grecian Bend Yields to Old Man River's Curves

In a recent issue, you named the Nolin River as America's most crooked stream. This is not literally true. The Mississippi River should be given that designation if the distance traveled by water and land is to be used as a gage. At New Madrid (Mo.) Bend, one travels forty-two miles around the bend, when from the head of the bend across the neck of land to Tiptonville is only two and three-fourth miles. Above and below Arkansas City, Ark., are other bends equally large, though the neck of the bend is not so narrow. Lake Village, Ark., formerly at the head of a large bend on the Mississippi, is now some thirty miles inland, situated on a half moon shaped lake formed when the river cut through the neck of the bend during high water. There are several other bends in Louisiana that are very similar in proportions to those cited. At Great Bend, Kans., is another rival of the Nolan River. A series of bends on the upper Missouri River cause the traveler to take his boat sixty-two miles around, but he can stand on a slight hill and look across to the foot of the bend only eight miles away.—C.G.W., Rockford, Ill.

Here's a New Way to Get Real Law Enforcement

I have been a reader of Popular Science Monthly for several years but have taken no part in criticism or suggestion in regard to your articles for as a whole your magazine just suits me and I have been content to leave well enough alone, but I can't help making a comment on the article by Mr. Teale in a recent issue. I think his article on new prisons is timely. Let us have more articles, and give us more definite figures as to what this crime wave is actually costing each individual. I am sure if we can get enough publicity on this subject the honest people will rise in revolt when they find out what it is costing them. Most of your readers seem to have sound minds and I think seed sown here would fall upon fertile ground. I know the average man, not connected with a law enforcement branch, does not realize what it means or what it is costing him or he would have been up in arms long ago.—J.W.C., Chillicothe, Ohio.

You Spray That Water to Run That Car

I am writing you with reference to a problem that I have been wondering about for six months or more. The problem is this: Why can't motors be built similar to Diesel engines and made to run on water? My theory is that instead of spraying fuel oil into the hot, highly compressed air in the cylinder, you inject a quantity of water. It seems to me this water would instantly change into live steam and create enough power to run the motor. Probably there's something wrong with this idea. Otherwise someone would have tried it long ago.—V.E.J., Pasadena, Calif.

Oh, Feet and Feet and Feet at Least—Maybe More

Here's one to exercise your ingenuity on: A certain rectilinear field was of such proportions, that the length was to the breadth, as the diagonal was to the length. If the breadth was 100 feet, how many square feet did the field contain? This isn't really more than half as difficult as it looks.—C.A.P., Monrovia, Calif.

Government Will Analyze Fake Cure-Alls for You

Answering the letter from F.A.W., Miami, Fla. I work at a place to which the Government sends a circular about condemned articles that are supposed to cure all kinds of pains, aches, and sickness. If you will be kind enough to get a bottle of one of these fakes, you would not only help yourself but many others by just sending it to the following address where it will be analyzed and if it does not contain the said ingredients it will be taken off the market. Send the bottle to United States Department of Agriculture, Washington, D. C.—W.C.K., Hempstead, N. Y.

Jove's Thunderbolts Get a Quite Modern Setting

Man made lightning leaped a thirty-foot gap, your splendid magazine tells us. Could have been sixty, had there been room, you add. Why only sixty? Why not six hundred? Or six thousand? What's the limit to voltage? Hasn't it occurred to anyone but me that here is a mighty weapon of war? A thousand yard lightning bolt could wipe out a regiment, a dozen regiments, or how many you got? Remember the legend of Jove's thunderbolts and the fire used to destroy distant enemy ships in the dim past of Greece's history? Maybe that wasn't all legend but merely the expiring flourish of a dying Atlantis civilization. I'll bet that neither you nor anyone else can prove I'm wrong.—M.J.H., Fleetwood, N. Y.

Why Your Fish Would Weigh What It Weighs and When

Answering the problem of L.W.R., Monroe, Mich., concerning some poor fishes. A fish weighs less in water than out because water, being heavier than air, it displaces more of its weight in water. If the air or gas in the bladder didn't weigh anything, how do you suppose the fish could contract the darn thing to make himself heavier? The fish if not actually heavier, in weight, is heavier in comparison to its two sizes which increase and decrease with the expansion and contraction of the bladder. Now if the air or gas weighed nothing, by contracting it he'd have a space full of nothing that would weigh something, or some such thing. The fish that you killed and the fish that you let suffocate would weigh the same in open air. But if they were weighed in a vacuum, the fish you killed would weigh the more, as it would still have air in it, while the one that you suffocated would have gradually lost all air.—T.P.S., New York, N. Y.

Anthropology Is His Long Suit and He Likes Fast Cars, Too

As a contribution to your "Our Readers Say" pages, I should like to say that I like your articles on archaeology and anthropology, etc., the best, and wish you would have more of them and less on radio and insignificant inventions. I like to read about racing cars and fast commercial cars, too, and enjoy the articles you have on these subjects. It's a good magazine though, after all.—J.R.T., Tustin, Calif.

Somebody Surely Is Bugs —And It May Be We

Your article on electric hotbeds gave me an idea—honest. As it's too good to keep to myself, here it is: Get those laboratory fellows to figure out a way of transforming radio waves into heat energy. Then big central stations could broadcast heat lightning to the farmers and garden truck chaps with a resulting enormous increase in output. Think of the starving people who could be fed. Think of the low prices that would still yield a profit. Think of the scramble back to the farm lands. Well, just think. Who's bugs now?—P.E.T., Hartford, Conn.

Gas, Not Dynamite, Is Blamed for Explosion

Referring to your article in a recent issue on "How Bomb Sleuths Trap Pineapple Murderers," I would say that I believe your photograph of the wrecked automobile is at variance with the description given. I believe this explosion was not caused by dynamite, but that it was an explosion of a gas tank. As you probably know, dynamite is a "high explosive." Its action is so rapid that the force is expended equally in all directions. If you lay a stick of dynamite on top of a rock, with no cover, and explode it there, the rock is shattered. Hang it on any side of the rock, but of course against the rock, and the same thing occurs when it explodes—the rock is shattered. A mixture of gasoline vapor or fumes mixed with from 2% to 5% of air makes an explosive only slightly less powerful than dynamite. It has the explosive effect of black powder as the force of the explosion is expended in the direction of least resistance. The force of the explosion that wrecked the car you showed was expended upward, and this gives it the earmarks of a gas tank explosion. One thing that is not generally known is that a charge of dynamite powerful enough to throw a 150 pound man upward through the top of an automobile would, literally, tear him into shreds. It is hard to explain to the general public that these things can happen. The very name dynamite has a fearsome effect on most persons, and juries would rather say that an explosion such as depicted was the effect of dynamite than to let on that it could be caused by gasoline.—C.G.W., Rockford, Ill.

Wouldn't We Look Sweet as a "Fashion Magazine"?

I agree with F.A.S., Darien, Wisc., that you probably are addle-headed by now. What next? A woman's page in a mechanical magazine! I suggest you leave Popular Science Monthly as it is—except you might add a little more chemistry. Also I should like to suggest to F.A.S., that she get some fashion magazines along with a couple of medical journals. Let's have more experiments. Some one come on with the solution that is used to treat gas mantles. I wish to experiment some with this.—J.H.T., Oklahoma City, Okla.

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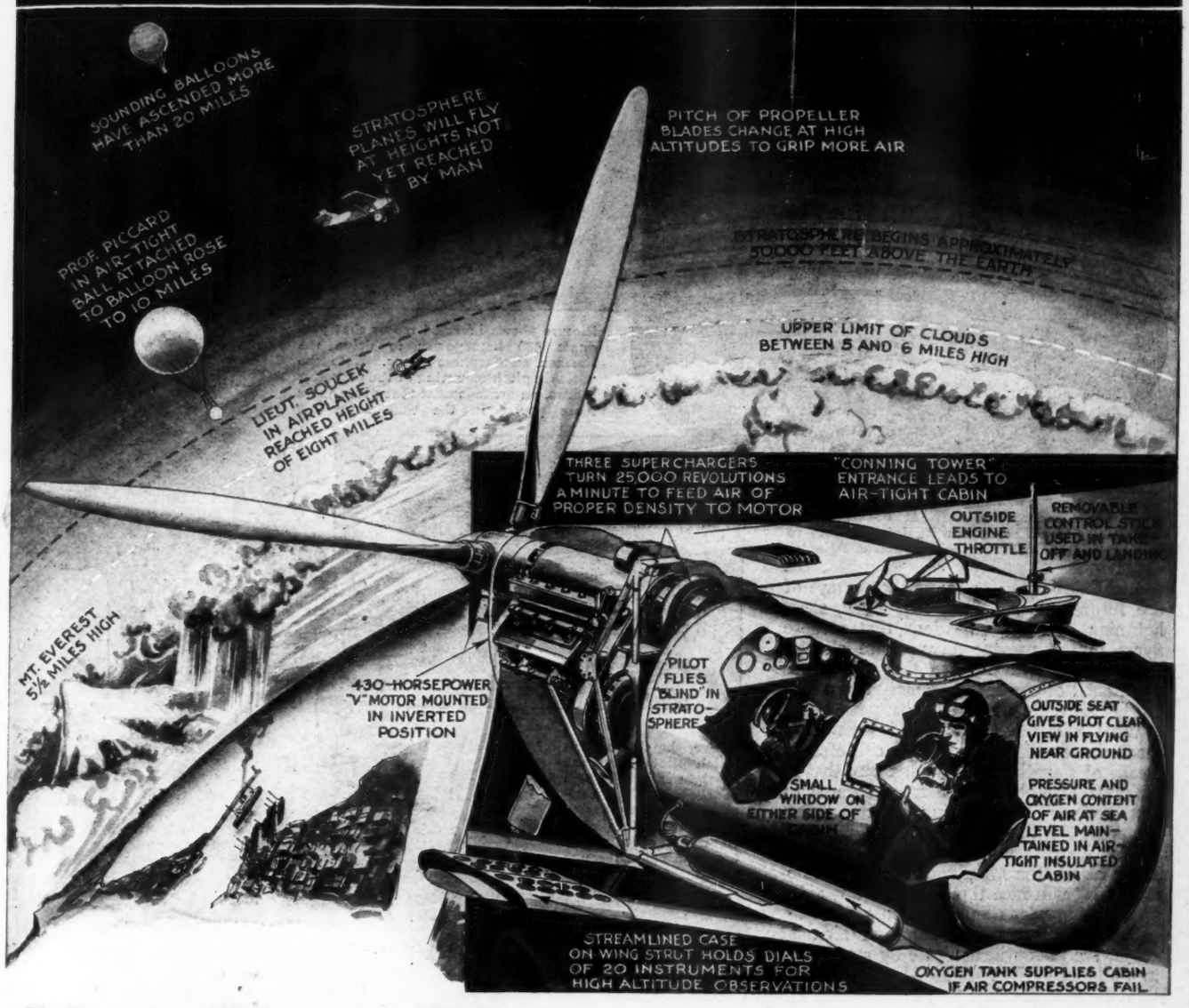
POPULAR SCIENCE
MONTHLY
October 1932 Vol. 121, No. 4
RAYMOND J. BROWN, Editor
·FOUNDED 1872·
SIXTY-FIRST YEAR


SOUNDING BALLOONS HAVE ASCENDED MORE THAN 20 MILES
STRATOSPHERE PLANES WILL FLY AT HEIGHTS NOT YET REACHED BY MAN
PROF. PICCARD IN AIR-TIGHT BALL ATTACHED TO BALLOON ROSE TO 10 MILES
LIEUT. SOUCEK IN AIRPLANE REACHED HEIGHT OF EIGHT MILES
PITCH OF PROPELLER BLADES CHANGE AT HIGH ALTITUDES TO GRIP MORE AIR
STRATOSPHERE BEGINS APPROXIMATELY 50,000 FEET ABOVE THE EARTH
UPPER LIMIT OF CLOUDS BETWEEN 5 AND 6 MILES HIGH
THREE SUPERCHARGERS TURN 25,000 REVOLUTIONS A MINUTE TO FEED AIR OF PROPER DENSITY TO MOTOR
"CONNING TOWER" ENTRANCE LEADS TO AIR-TIGHT CABIN
OUTSIDE ENGINE THROTTLE
REMOVABLE CONTROL STICK USED IN TAKE-OFF AND LANDING
MT. EVEREST 5½ MILES HIGH
430-HORSEPOWER "V" MOTOR MOUNTED IN INVERTED POSITION
PILOT FLIES "BLIND" IN STRATOSPHERE
SMALL WINDOW ON EITHER SIDE OF
OUTSIDE SEAT GIVES PILOT CLEAR VIEW IN FLYING NEAR GROUND
PRESSURE AND OXYGEN CONTENT OF AIR AT SEA LEVEL MAINTAINED IN AIR-TIGHT INSULATED CABIN
STREAMLINED CASE ON WING STRUT HOLDS DIALS OF 20 INSTRUMENTS FOR HIGH ALTITUDE OBSERVATIONS
OXYGEN TANK SUPPLIES CABIN IF AIR COMPRESSORS FAIL

High-Flying Planes POISED TO Race SUN *across* Atlantic

By EDWIN TEALE

CARRYING within its fuselage an air-tight cabin shaped like a metal capsule, a silver-white monoplane soared into the air near Paris, France, a few days ago. Built secretly behind locked doors at the Farman plant, it is the latest entrant in an international race to conquer the stratosphere—the thin air ten miles above the surface of the earth.

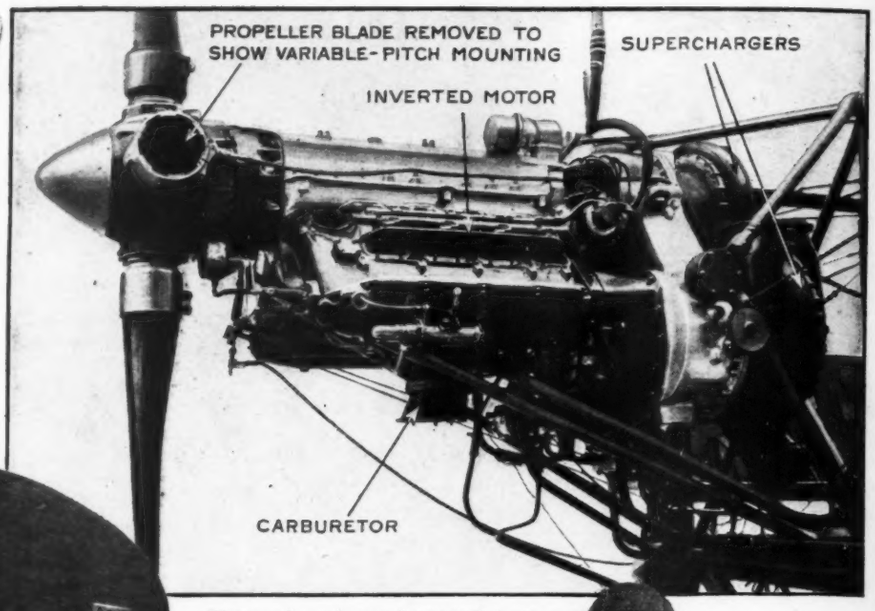
Shortly before that, workmen at the Junkers' factory, Dessau, Germany, had completed a strange machine with a slender body and an enormous seventeen-foot propeller, also designed to fly in the stratosphere. Its preliminary, low-altitude tests completed, it is now poised waiting perfect weather for its first dash to the upper levels of the sky.

A third machine, a huge monoplane with wings of variable area designed by the French engineer, M. Guerchais, is receiving its finishing touches as this is written. This craft, its inventor predicts, will be able to climb to an altitude of ten miles in forty minutes.

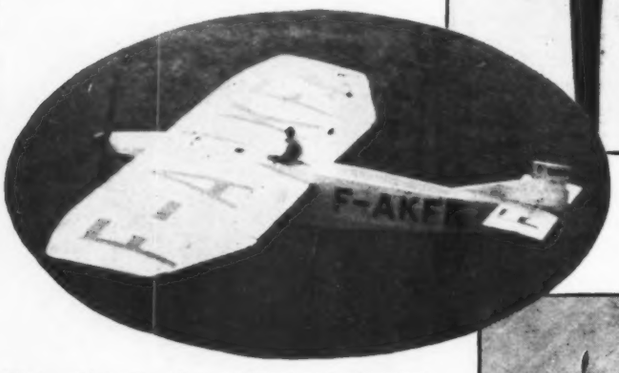
Within the next few weeks, one or more of these planes may blaze a trail into the rarefied air above the 50,000-foot level. In this region of bitter cold and steady winds, aero-

Germany's stratosphere plane, built at the Junkers factory, has been tested at low altitudes and is now waiting perfect weather for its first climb to great height

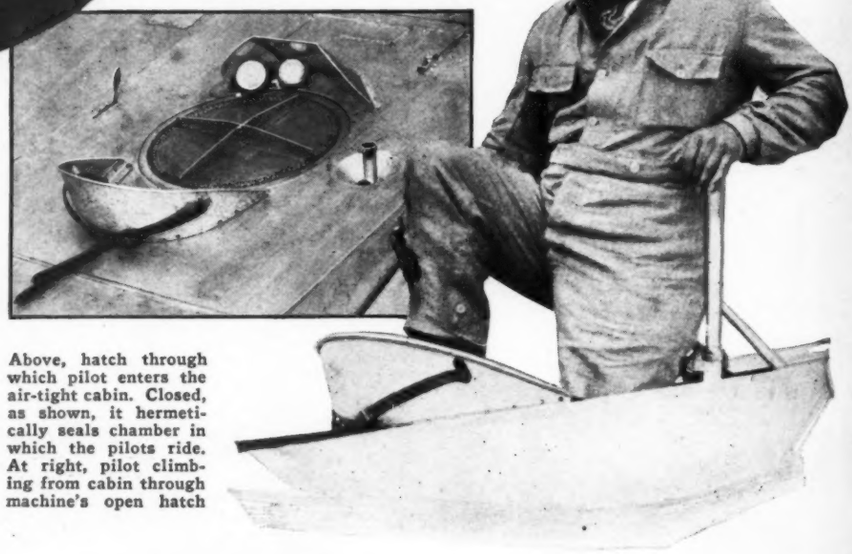
High-flying plane designed by a Frenchman has variable wings and will be tested soon



Picture shows inverted motor that produces 430 horsepower to drive the Farman stratosphere plane. Note the variable pitch mounting of the propeller blades, an arrangement that gives them more power in the thin upper air



Silver white monoplane, built at Farman plant near Paris, is all ready for its initial effort to rise 50,000 feet and race the sun across Atlantic



Above, hatch through which pilot enters the air-tight cabin. Closed, as shown, it hermetically seals chamber in which the pilots ride. At right, pilot climbing from cabin through machine's open hatch

nautical authorities agree, lie the airways of the future. Storms, rain, fog, snow, sleet, lightning, and shifting winds that menace flyers in the present airways are all left behind in the stratosphere, that mysterious outer shell of the earth's atmosphere which no heavier-than-air craft has penetrated.

What will these pilots find when they reach the top of the sky? Data collected by means of sounding balloons indicate that at different levels of the stratosphere swift "trade winds" blow continually from different points of the compass and provide "tail winds" for planes heading in any direction. Miles above the highest clouds, the "thin-air ships" will race through clear air, aided by favoring winds and uniform weather.

Guiding his machine from an air-tight cabin, the pilot will navigate by stars that shine day and night, in a blue-black sky. We see the stars disappear and the sky turn light blue in daytime because we look upward through a haze of reflected sunlight. In the stratosphere, above this haze, the sky is always black, the stars shine continually, and the sun gives off the harsh glare of a searchlight.

Favoring winds and the thinness of the air will make possible tremendous speeds. Engineers predict the Farman plane may rush beneath the jet black sky at 400 miles an hour; favoring winds may add another 100 miles. Such speeds would bring Paris within eight hours of New York and make possible a round trip between America and Europe in less than twenty-four hours. At the latitude of Paris, a plane going 500 miles an hour could circle the world in a single day.

Because this is true, the first pilot to head westward from the French capital at 500 miles an hour literally will race with the sun. Because he will be going fast enough to circle the earth in twenty-four hours, he will remain in a fixed position in relation to the sun while the earth is spinning beneath him. If the Farman plane heads west at that pace, its pilot, Lucien Coupet, will be the first man since Joshua to see the sun stand still in the sky!

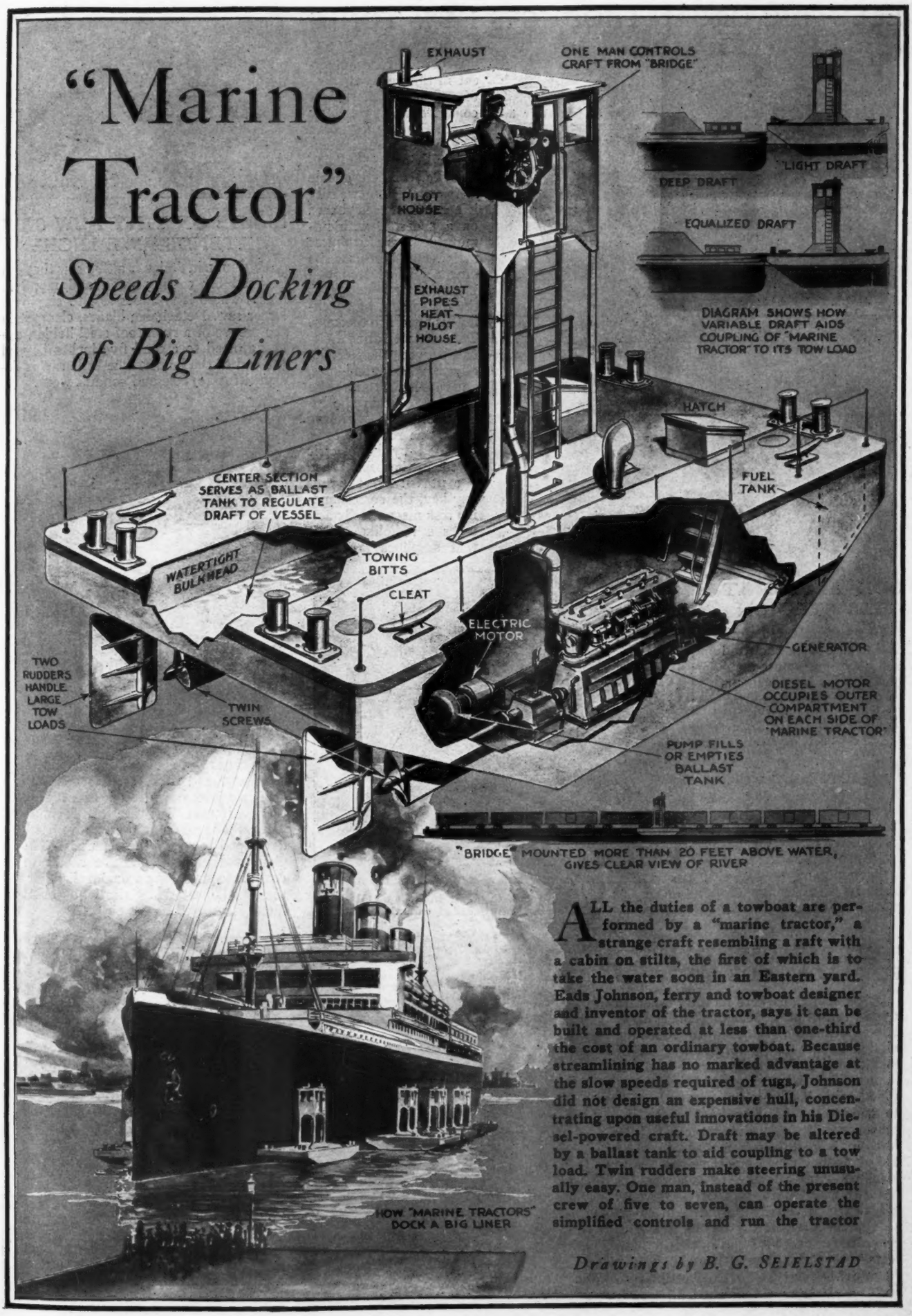
However, the thinness of the upper air which makes such tremendous speeds possible also accounts for some of the greatest difficulties the designers of high-flying planes had to overcome. Stratosphere ships will fly at a height where the pressure is less than one-eighth that of sea level and where no breathing thing can exist because of insufficient oxygen.

When spectators crowded around the Junkers and Farman planes on their first appearance, the feature that interested them most was the air-tight metal cabin designed to protect the pilot against these dangers.

On the Farman, the cabin is a duralumin cylinder seven feet long and three feet in diameter, shaped like a capsule. You enter from the top of the fuselage through a round "conning tower" and descend into what seems to be a miniature submarine. Two seats, one in front of the other, are fitted with dual controls. Electric bulbs light the interior, for the only openings that permit sunlight to enter, or the pilots to look out, are small portholes, one on either side of the cabin. Just outside the left porthole, a streamlined case on a wing strut holds the dials of twenty instruments for making observations during trips to the stratosphere.

At the start of a flight, one pilot crawls forward and takes his place in the leading seat. The other, perched high on the back of the fuselage where he has a clear view in all directions, guides the plane into the air, using a small demountable control stick and auxiliary rudder pedals. At ten or fifteen thousand feet, he signals the other pilot in the "blind" cabin below who takes control, flying by instruments. Then the "take-off" pilot, who also lands the plane, clambers down, *(Continued on page 96)*

"Marine Tractor" *Speeds Docking of Big Liners*


EXHAUST
ONE MAN CONTROLS CRAFT FROM "BRIDGE"
PILOT HOUSE
EXHAUST PIPES HEAT PILOT HOUSE
LIGHT DRAFT
DEEP DRAFT
EQUALIZED DRAFT
DIAGRAM SHOWS HOW VARIABLE DRAFT AIDS COUPLING OF "MARINE TRACTOR" TO ITS TOW LOAD
HATCH
FUEL TANK
CENTER SECTION SERVES AS BALLAST TANK TO REGULATE DRAFT OF VESSEL
WATERTIGHT BULKHEAD
TOWING BITTS
CLEAT
ELECTRIC MOTOR
GENERATOR
TWO RUDDERS HANDLE LARGE TOW LOADS
TWIN SCREWS
DIESEL MOTOR OCCUPIES OUTER COMPARTMENT ON EACH SIDE OF "MARINE TRACTOR"
PUMP FILLS OR EMPTIES BALLAST TANK
"BRIDGE" MOUNTED MORE THAN 20 FEET ABOVE WATER, GIVES CLEAR VIEW OF RIVER
HOW "MARINE TRACTORS" DOCK A BIG LINER

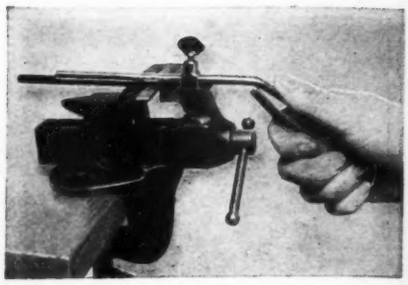
ALL the duties of a towboat are performed by a "marine tractor," a strange craft resembling a raft with a cabin on stilts, the first of which is to take the water soon in an Eastern yard. Eads Johnson, ferry and towboat designer and inventor of the tractor, says it can be built and operated at less than one-third the cost of an ordinary towboat. Because streamlining has no marked advantage at the slow speeds required of tugs, Johnson did not design an expensive hull, concentrating upon useful innovations in his Diesel-powered craft. Draft may be altered by a ballast tank to aid coupling to a tow load. Twin rudders make steering unusually easy. One man, instead of the present crew of five to seven, can operate the simplified controls and run the tractor

Drawings by B. G. Seielstad

ELECTRIC ORGAN PRODUCES NEW TONES

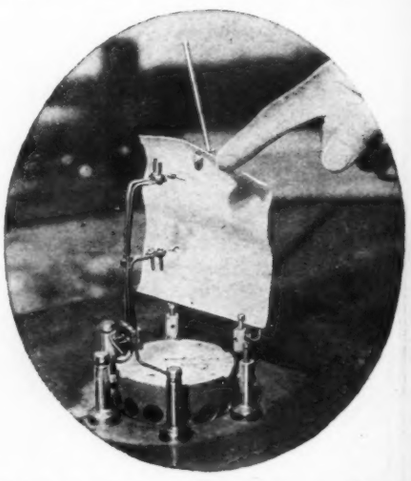
In this "gnome" organ, the tones, electrically produced, differ from those of any other instrument and are heard through a loudspeaker

MUSICAL tones different in timbre from those of any other instrument come from a new electric organ. The inventor, Ivan I. Eremeeff, Russian engineer living in Philadelphia, Pa., calls it a "gnome instrument." Outwardly it consists of a keyboard on a pedestal, with immovable keys of stainless metal. The performer sits upon a stool covered with japanned metal and plays the instrument by touching his fingers to the keys. This contact forms a circuit between the electrically-wired stool and keys, and causes the tones to be sounded. Within the instrument are whirling disks, one for each tone, operated by an electric motor in the base. When the performer touches any key, the corresponding disk magnetically actuates a radiolike circuit that amplifies the tone.



BLADE ON TINY NEW SAW EXTENDS FIVE INCHES

UNUSUAL in design is a tiny saw that can be used for cutting wood and metal in places where it is impossible to employ a larger saw. Detachable blades, clamped in the groove of a rustproof steel holder, can be adjusted to extend five inches beyond the end of the holder. The little saw is designed for keyhole and conduit work.

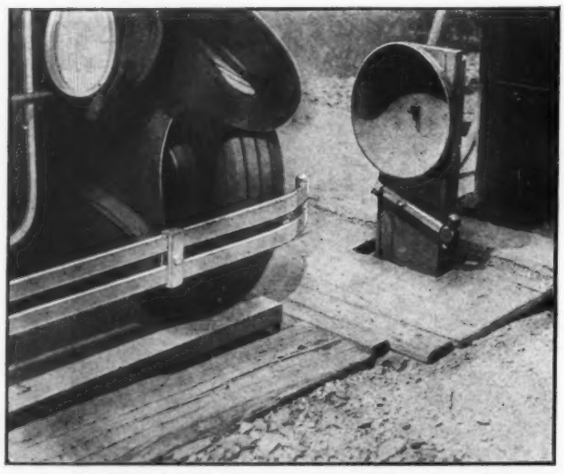


GOLD SPRAYED ON WOOD

EVENING gowns of shimmering platinum, and wood and paper articles coated with gold, are forecast by recent experiments at the California Institute of Technology, where the apparatus shown above has been developed to apply these metals. When a piece of the metal and the object to be coated are placed in a vacuum chamber and the first is heated electrically, a "mist" of metal is sprayed on the object.

ODD ALARM AT GAS STATION

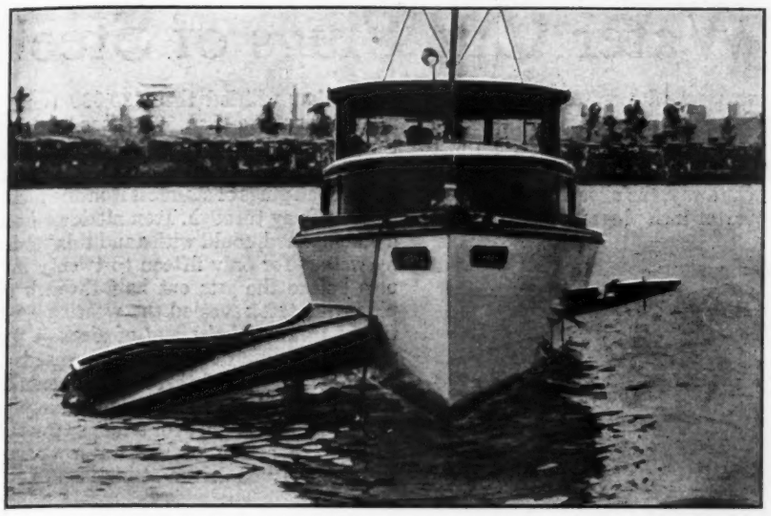
SO THAT he could work at the back of his shop and still serve customers stopping for gas, an ingenious garage man constructed the alarm device, shown in the photograph at the right, from an old trolley gong, a hammer, a short length of chain, and old trolley ties. When a motorist drives into the position shown by the car in the photo, the lever in the roadway is depressed, actuating the gong and summoning the garage man. As soon as the car moves on the gong stops.



When a car is driven across the lever in front of this gas station, the alarm, automatically sounded, calls the salesman

RAILROAD USES TOYS TO FIND LOSS DUE TO WIND

TOY-SIZED trains were recently taken to a wind tunnel at Teddington, England, to help experimenters learn how to reduce the wind resistance and power consumption of engines and cars. Strung upon a steel bar connected to balances outside the tunnel, a model six-coach train was thus exposed at an angle to the roaring gale of an airplane propeller while the engineers measured the forces striking it from front and side. Models of individual locomotives were also hung on wires attached to balances, for tests at wind speeds as high as seventy miles an hour. The picture at right shows an experimenter setting up the model of the train in front of the powerful blast from the whirling airplane propeller. The force of the air current is carefully gaged to ensure accuracy of the data.



When the driver of this speedboat fell overboard as he made a sharp turn, the craft dashed ahead, struck a yacht, and drove its sharp prow completely through the hull

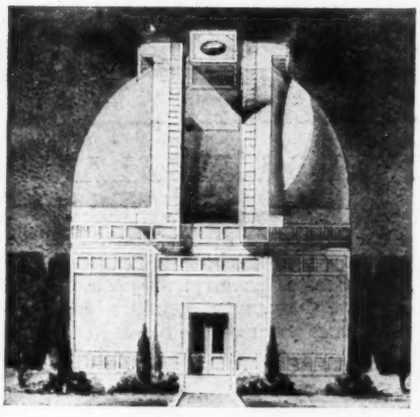
SPEEDBOAT PROW PIERCES YACHT

AT A Chicago regatta, not long ago, a speedboat hurled its prow at forty-five miles an hour against a large yacht with the result pictured above. The freak accident occurred when Fred Harvey, driver of the speedboat, fell overboard and the boat roared on. No one was hurt.

CAR'S SEAT-LIKE BUMPER SAVES PEDESTRIAN'S LIFE

WHEN a new safety bumper, invented by an Englishman, is attached to the front of a car, it is said to be virtually impossible for a motorist to run over a pedestrian. The bumper, shaped like a seat, is padded with sponge rubber. If a person is struck, he is knocked into a sitting position and carried along on the bumper. The inventor, A. J. Grafham of London, permitted himself to be run down by a car equipped with his device and escaped without injury.

Shaped like a seat and padded with sponge rubber, this new auto bumper is lifting a pedestrian out of danger

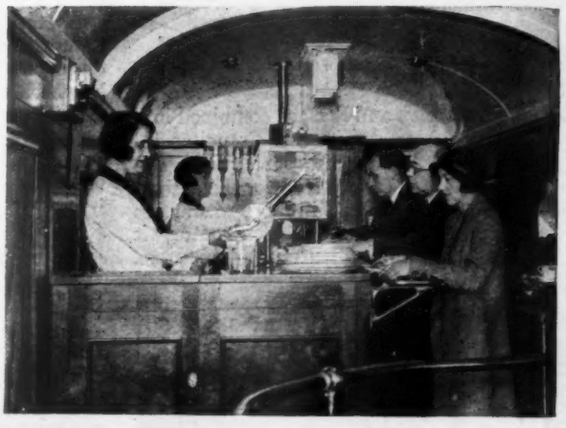


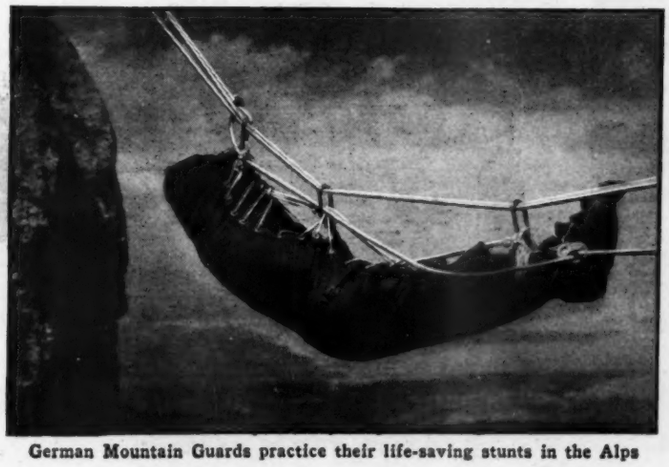
UNUSUAL DOME HOUSES BIG NEW TELESCOPE

A MODERNISTIC dome of welded steel will house a photographic telescope now being built for the Naval Observatory at Washington, D. C. Light from nearby lamps will be kept from the telescope by the collapsible, tubular shade visible at the top.

CAFETERIA ON FAST TRAIN

A CAFETERIA for Pullman passengers was installed recently by an English railway. While the train rushed along the passengers filled their trays in the cafeteria compartment of the Pullman. The success of the cafeteria car is expected to lead to the adoption of the idea on all trains of the system. Photo at right shows car with countergirl and barmaid.





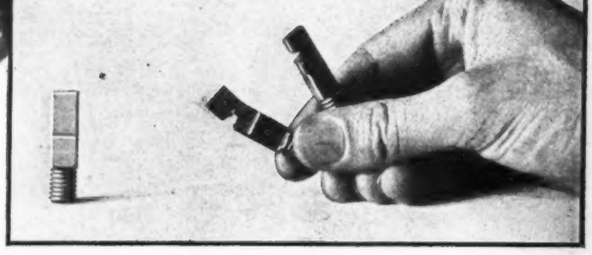
German Mountain Guards practice their life-saving stunts in the Alps

VICTIMS IN ALPS SAVED BY CABLE

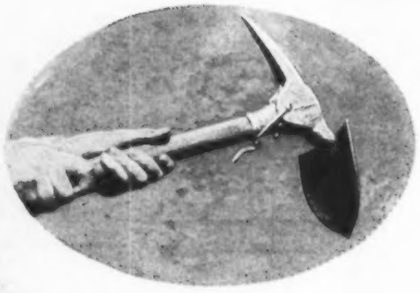
How injured mountain climbers are brought back safely to the hospital was demonstrated recently in thrilling practice maneuvers by the German Mountain Guard. Formed twelve years ago to patrol the German Alps and rescue climbers in distress, this organization saves as many as 400 lives in a single year. Often it is necessary to fashion a cable "railway" to swing an injured climber across chasms by an aerial route, and the practice exercises train rookie members of the guard in this difficult work.

Jets of Water Cut Plugs of Steel

CUTTING steel with water is a feat recently performed by Westinghouse research engineers at East Pittsburgh, Pa. To test the rate at which different metals wear away, the experts screwed two quarter-inch plugs into the rim of a wheel that whirled them 20,000 times a minute, or more than 300 times a second, through two jets of water the size of a lead pencil. In less than three minutes, the water had eroded plugs of stainless iron and nickel-steel halfway through. Iron nitride, almost diamond-hard, could withstand this "ordeal by water" for only fifteen to twenty minutes before the jets cut half through the plug. The test revealed the wearing qualities of turbine blades and of airplane propellers whirling at tremendous speeds in rain. As a result of these experiments efforts will be made to develop an alloy capable of withstanding for a longer time the destructive action of the water through which it may be driven at high speed.



Steel plugs set in rim of wheel are whirled through jets of water at 20,000 revolutions per minute. At right, view of plugs cut nearly in two by the water



SHOVEL, PICK AND HOE COMBINED IN ONE TOOL

SHOVEL, pick and hoe are combined in a new tool designed by a San Francisco inventor and shown in the photograph. The implement may be adjusted for the desired use and locked securely in place within five seconds. According to the inventor, it should prove especially useful to gardeners.

SAFETY WHEEL FOR CAR ENDS BLOWOUT WRECKS

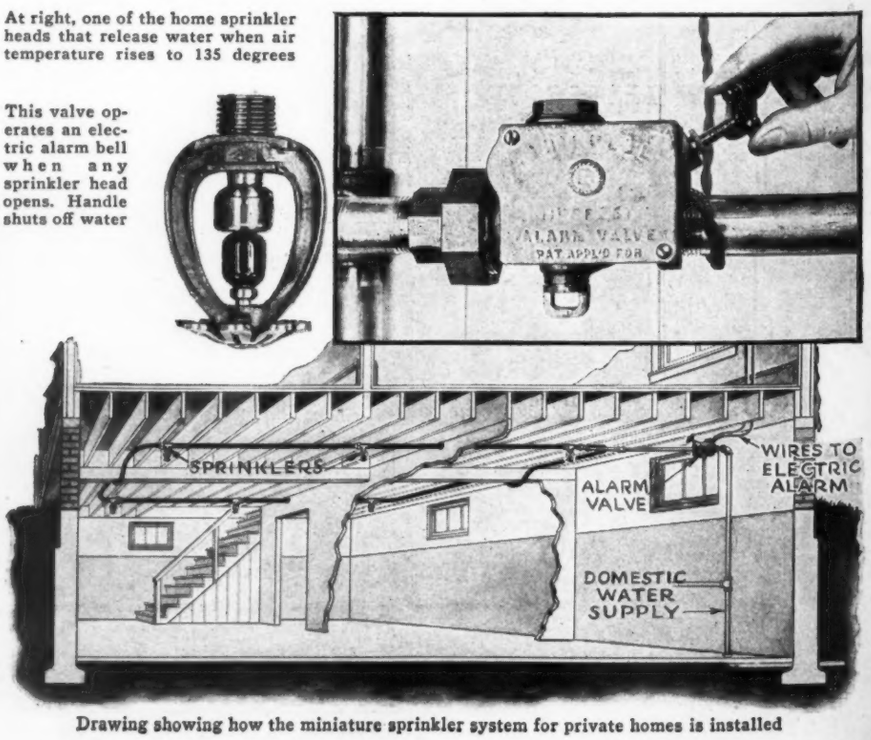
DELIBERATELY wrecking a tire by driving over large bolts and nuts, a Pittsburgh, Pa., inventor recently demonstrated his new "safety wheel" to prevent a driver from losing control after a blowout. The car's weight drops on a metal disk faced with solid rubber, attached to the wheel.

HOME SPRINKLER SOUNDS FIRE ALARM

A MINIATURE sprinkler system to protect private dwellings from fire has just been perfected and placed on the market. Though it resembles the larger outfits that guard office and industrial buildings, each part has been especially adapted for domestic use. The new apparatus is installed in the cellar of a home, where statistics show a large percentage of fires start. It is connected to the household water supply. When flames raise the air temperature to 135 degrees, the nearest sprinkler head opens and pours water on the blaze. At the same time, it rings an electric alarm bell.

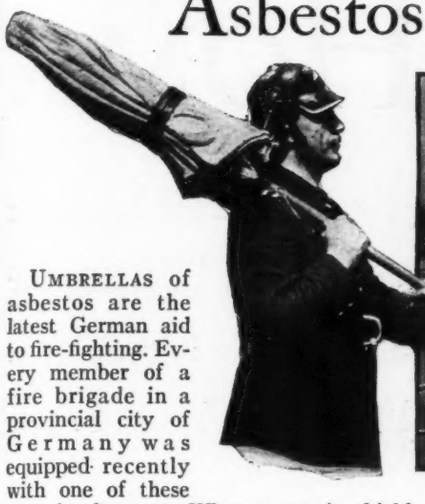
At right, one of the home sprinkler heads that release water when air temperature rises to 135 degrees

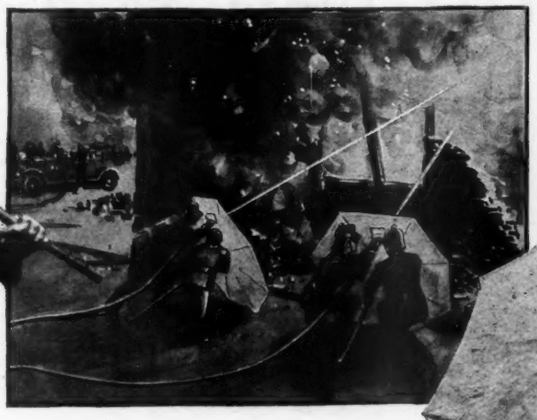
This valve operates an electric alarm bell when any sprinkler head opens. Handle shuts off water

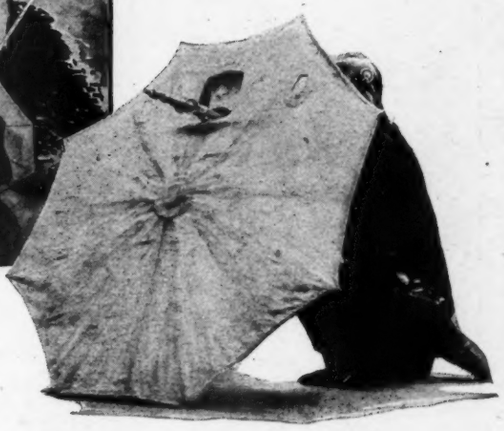


Drawing showing how the miniature sprinkler system for private homes is installed

Asbestos Shield Protects Firemen



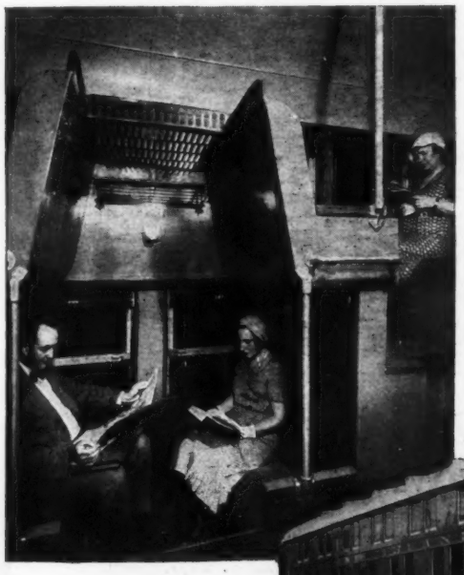




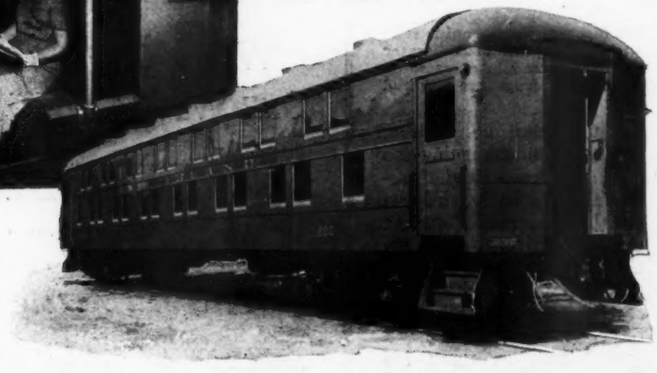
Below, asbestos umbrella with opening for hose used to protect firemen near blaze. At left, drawing shows how umbrella is used in getting close to burning structure. At far left, umbrella folded for carrying

UMBRELLAS of asbestos are the latest German aid to fire-fighting. Every member of a fire brigade in a provincial city of Germany was equipped recently with one of these new implements. When open, it shields him from the most intense heat so that he can play his hose on the blaze at close range. An aperture is provided in the umbrella for this purpose. For carrying and storage, the device is quickly folded. The idea for this invention is said to have been taken from asbestos screens employed by sprayers of liquid fire in the world war.

RAILWAY INSTALLS TWO-STORY CARS



DOUBLE-DECK coaches, an innovation in railway travel, were recently placed in service by the Long Island Railroad to carry commuters to and from New York City. The seats are arranged in upper and lower tiers. To reach a seat on either level, a passenger steps up or down from a single raised aisle running the length of the car. Because of the unusual seating plan, the new coaches accommodate 120 passengers. Substitution of the double-deck cars for the standard seventy-six-passenger coaches hitherto used is expected to relieve congestion at rush hours.

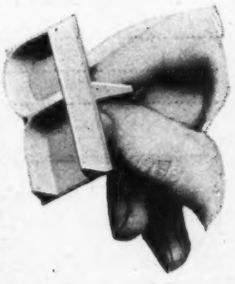


Right, exterior of new double-deck railway coach with two rows of windows and upper and lower row of seats. Above, close-up of the double tier of seats

MACHINE TEACHES FAST WORK AT TYPEWRITER

To SPUR typewriting students to greater speed, a Portland, Ore., high school instructor devised the practice machine shown above. A series of words passes continuously across a window at the front of the cabinet. The student is required to copy them. A second's delay and the words are past the window and permanently lost to view. Turning a knob slows down the procession of words, and the dial may be set and locked by the instructor at any speed from ten to 120 words per minute.

LETTERS MARK CEMENT



LETTERS of aluminum, with finger-holds on the back, are now used to print signs in cement. Pressed down into the wet cement, they form indented words. Used with a straight edge, the aluminum stamps produce clear-cut lettering with a minimum of effort and of time, according to the manufacturer.

MOVE FREIGHT IN TRAILERS

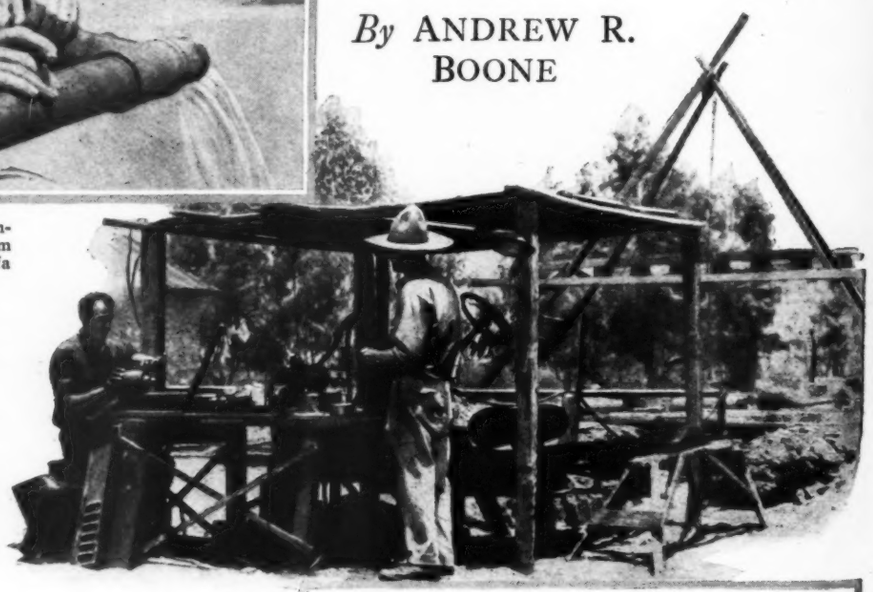
A CURIOUS train of trailers, pulled by a three-ton truck "engine," passed recent tests in England. Rolling along on twenty-four balloon tires, the three trailers, each carrying fifteen tons of freight, followed the pulling truck in a thrilling demonstration. The train is designed for hauling freight in the tropics and Far East.

Help Yourself *to a* HOME

Uncle Sam Still Has Millions of Acres of Land Waiting for Settlers and Thousands Are Now Filing on Western Farms

By ANDREW R. BOONE

Eslie Wynn, once a jeweler, is now a confirmed homesteader living on his 160-acre farm in southern California and busy raising alfalfa



A discarded auto engine runs this pump and raises water that is stored in a reservoir until the crops are watered

MIX shallow water with reasonably suitable soil and add $250 in small installments. There you have a successful homesteader's formula for the acquirement of a home on 160 acres of some 200,000,000 acres of Government land yet available to the American public.

Today thousands of people are turning to the public lands, establishing the homes they long have wanted and finding in the wide open spaces of southwestern deserts and northwestern prairies and in western mountains the freedom of which they dream.

Before the current economic unpleasantness the general land office at Washington received some fifty inquiries a day from persons interested in getting a piece of Uncle Sam's land. Now as many as a thousand inquiries are received in a single day.

Eslie Wynn, who gave me his formula for successful homesteading, no longer is interested in the struggle for land. He has his; has increased its value from nothing to at least $40 an acre, for recently he sold a twenty-acre piece at that rate. And now he lives comfortably in his $200 stone home, oversees a helper who raises his alfalfa and vegetables and, as a sideline, conducts a small store and gasoline pump thirty-two miles from the nearest town in the heart of Borego valley in southern California.

Wynn's story is typical. When he first went onto the desert a few years ago, after having served two decades behind a jeweler's counter, his automobile could not carry him to the plot he had picked out on a map. He paid a rancher $12 for the use of four burros to get his belongings to the center of the valley.

Wynn slid off one of the little "desert canaries" at the end of a hard day's ride and where he planted his feet he decided to stay. For a year he lived in a tent cabin, meantime drilling for water and fencing his plot. When I visited Borego valley recently, to learn for the readers of POPULAR SCIENCE MONTHLY from the homesteaders themselves how they have accepted the Government's offer of free homes, I found him swinging his feet from the counter of his tiny store while across the sandy road an automobile engine, bought from a junk dealer for $5, was turning a $15 pump that lifted water from two wells into a shallow reservoir to water his alfalfa.

I had driven my car thirty-two miles through a narrow mountain canyon after leaving the paved highway. Roads, little more than hard-packed trails, make it possible today for many homesteaders to take up land where a few years ago they could not easily reach a chosen plot.

I met one young fellow with a broken-down truck halted alongside the narrow trail. After I had offered such help as lay within my power, I inquired about his work. During the day, he told me, he drives the truck for a near-by ranch and each evening he turns the nose of his flivver south to his homestead, seven miles

Where Government Land Still Waits for the Homesteader

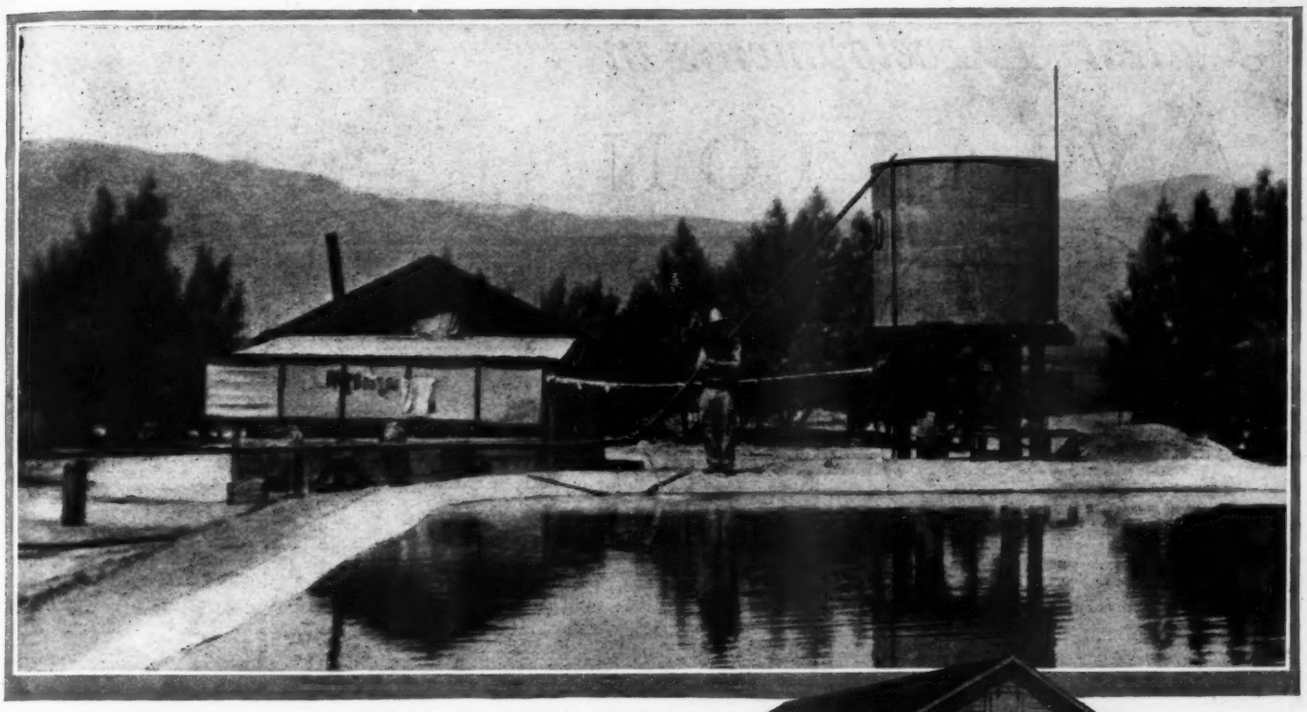
California	16,046,000	acres
Nevada	51,399,000	"
Utah	25,157,000	"
Alaska	346,037,591	"

Small Amounts in:

Idaho, Oregon, Washington, Colorado, Montana, Arizona, Arkansas, Nebraska, Florida, New Mexico, Minnesota, South and North Dakota, Kansas

Filing Fee:

160	acres	$16 to $22
320	"	$22 to $34
640	"	$34 to $58



From two shallow wells, water is pumped by motor to fill this reservoir from which a supply is drawn as needed to irrigate dry but fertile fields

distant. In the evening, on Sundays, and at odd times when work is slack, he builds fences, clears land, and works his crops. A couple of months' work gets food for the rest of the year. Meantime he's perfecting his patent and in another year will own 160 acres, with water supplied from a twenty-five-foot well.

His is one of the 63,000 homesteads now being taken up.

Large acreage is still available today, but in Texas, Georgia, North and South Carolina, Tennessee, Kentucky, Missouri, Iowa, Illinois, Indiana, Ohio, the Virginias, Maryland, New Jersey, Pennsylvania, New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine none can be had.

While waiting for irrigated desert land to grow crops, many settlers raise flocks of turkeys for the market

Small amounts can be had in Michigan, Wisconsin, Kansas, Oklahoma, Mississippi, Alabama, and Louisiana.

All but one million acres of the public lands available for homesteading lie in the eleven western states. But how do you get it?

In the first place, there are three general types of homesteads: 160 acres for ordinary farming with water, 320 acres for dry farming, and 640 acres for stock raising. For the first of these you pay a filing fee ranging between $16 and $22, depending on the value Uncle Sam places on the land; a fee of $22 to $34 enables you to move in on the dry farming plot, while $34 to $58 secures the stock raising homestead.

When you apply, the land agent in your district will tell you whether the piece you want has been withdrawn for forest or some other purpose. If it has been withdrawn he still will forward your application to the General Land Office, Department of Interior, at Washington, since the reason for withdrawal may have disappeared and you still may get the land.

The Government is generous with homesteaders, once they have been permitted to file an application, but it is a strict disciplinarian. You can't get a piece if the Secretary

Typical homesteader's desert dwelling house. The front room is used as a store

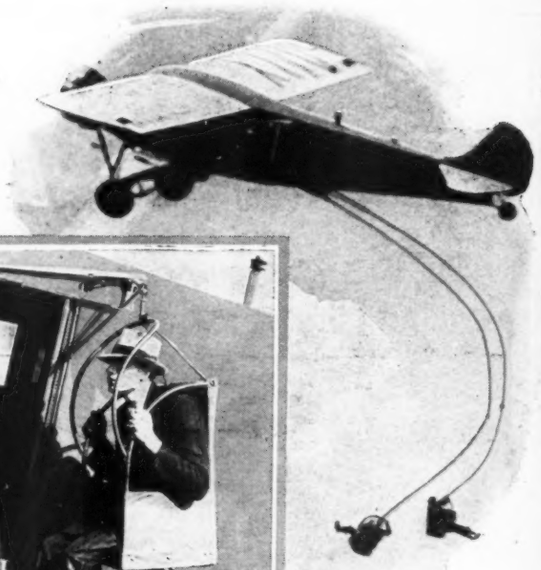
of the Interior is convinced you can't make a living on it; yet, if you are trying honestly to improve the homestead, the department will go great lengths to keep you there.

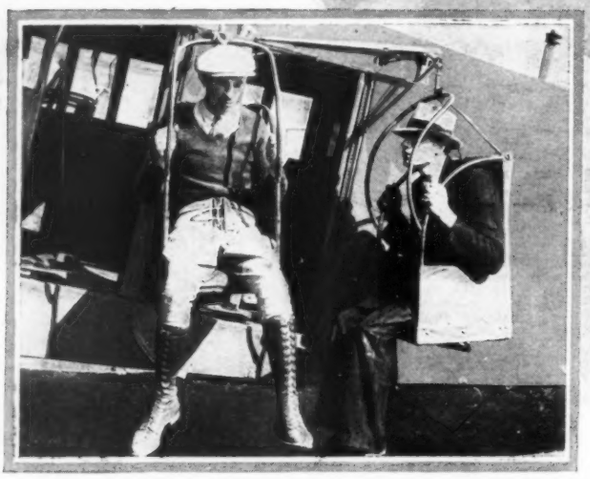
If you fought in any war Uncle Sam will waive some of the residence requirements, making allowance for the months you spent in uniform. Not only do ex-soldiers and the widows of veterans who died in service have preference in claiming homesteads, but they need live on the land during only part of the term. Generally speaking, the veteran must continue his residence and cultivation only for such period as will, when added to the time of his service, equal three years. An ex-soldier with nineteen months of service may fulfill the residence requirements in seven months.

Most of the 63,000 homesteaders now perfecting their titles took up the type of homestead that requires them to live on the land while improving it. Frank B. Osborne can tell you how to accept the Government's offer of free land, for he and his wife are just now ready to make final proof that they have lived twenty-one months on their 160-acre desert homestead during the last three years and that they have made all the improvements required, besides raising watermelons, tomatoes, and corn.

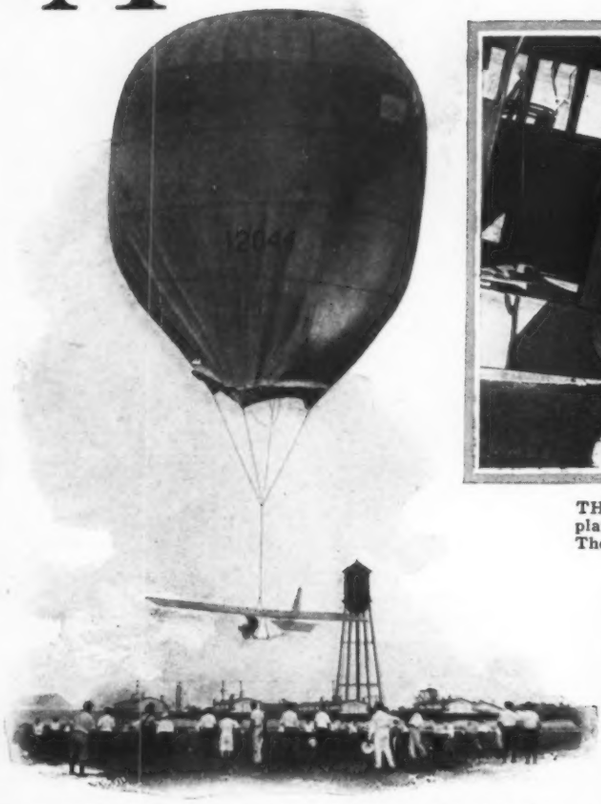
Three and a half years ago Osborne decided he was *(Continued on page 97)*

Latest Developments in AVIATION





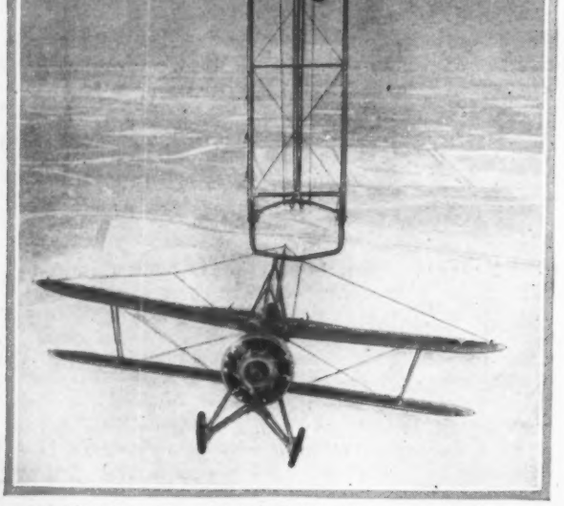
THROWN OUT AT 2,000-FOOT ALTITUDE. When the pilot of a crippled plane works this emergency passenger-dumper, doors open and seats swing out. The next moment passengers start earthward at end of 'chutes as at upper right



BALLOON LIFTS GLIDER. Attached to a hot air balloon, this glider was carried aloft for a test flight at Aurora, Ill. Cutting loose from the balloon, the glider flew at a good rate of speed for four minutes, driven only by three exploding rockets

'CHUTE DROPS PARCELS

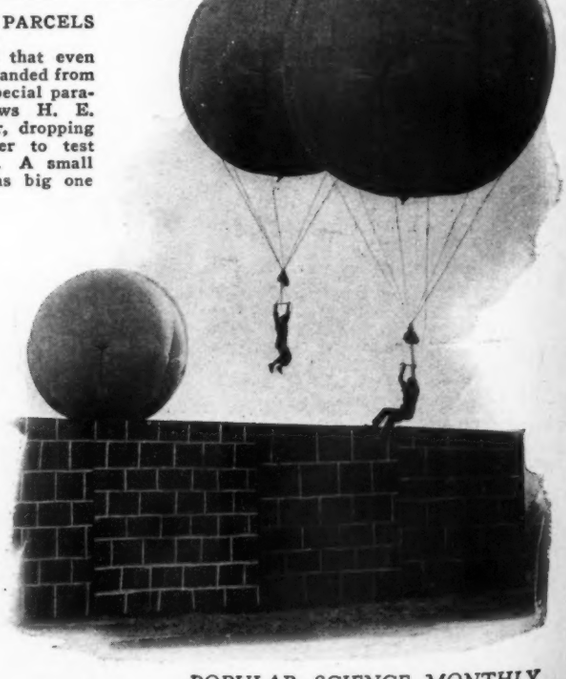
Recent tests proved that even fragile cargo can be landed from an airplane with a special parachute. Picture shows H. E. La Fayette, inventor, dropping an airplane propeller to test the cargo parachute. A small pilot parachute opens big one



HOOKING TO BIG AIRSHIP. This unusual picture shows a high speed plane grabbing the trapezelike contraption that lifts it aboard the *Akron*. In the background can be seen the wing of a second airplane that also hooked on

JUMPING PILOTS

During a recent aerial demonstration at Rome, Italy, over 400 airplanes and many balloons took part in the unusual stunts. Photo at right shows the human fly race in which military aviators, tied to balloons, leaped lofty obstacles set in their way



EXIT
SPECIAL HEAT-SENSITIVE WIRE, CONCEALED BEHIND PICTURE MOLDING, DETECTS FIRE AND OPERATES ALARM SYSTEM
FIRE SETS OFF ALARM A FEW SECONDS AFTER IT STARTS
GREEN ARROWS LIGHT AUTOMATICALLY AND POINT WAY TO NEAREST EXIT
LOUDSPEAKERS ANNOUNCE THERE IS A FIRE AND GIVE DIRECTIONS TO AVERT PANIC

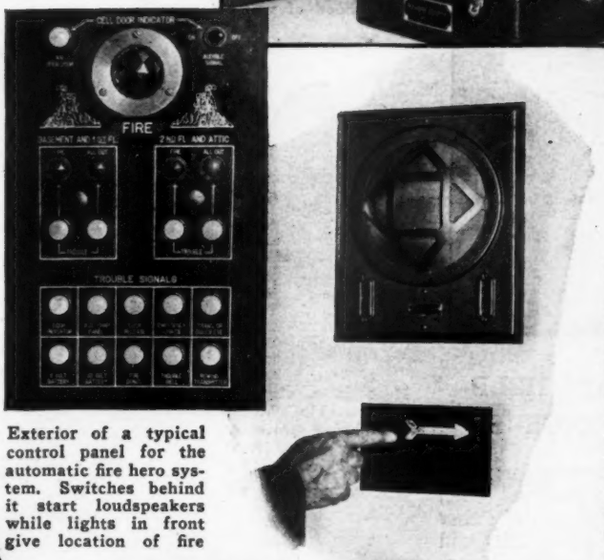
Robot Hero PREVENTS *Fire Panic*

Above, a phonograph playing band music and sounding fire warning. Installed within fireproof walls, its amplified tones reach every part of the building through loudspeakers, like the one shown at left. Note lighted arrow pointing way to exit

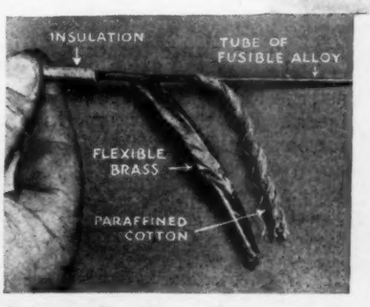
JUST as a cool-headed man may halt a panic when fire starts in a crowded theater, by ordering the orchestra to play and the audience to file out calmly, so a new "automatic fire hero" plays the same role mechanically. Unlike the human hero, whose presence cannot always be counted upon, this amazing electrical system is constantly ready.

When a sensitive electric wire strung through the building detects fire, it sets the system into action through a central control panel. Green arrows, lighting up in the halls, point the way to exits. Meanwhile a phonograph starts. Its amplified tones issue from loudspeakers scattered throughout the building.

Records are suited to the type of building—theater, school, or lecture hall. Pupils in a schoolroom hear, first, a flare of trumpets, and then a distant siren, followed by a calm voice saying, "There is a fire emergency but no immediate danger. You must leave the building. You are drilled in this and know just what to do. Leave your hats and coats, take your places in line. Steady now; don't rush. Follow the green arrows." A brass band strikes up. Through the music are heard approaching sirens.



Exterior of a typical control panel for the automatic fire hero system. Switches behind it start loudspeakers while lights in front give location of fire

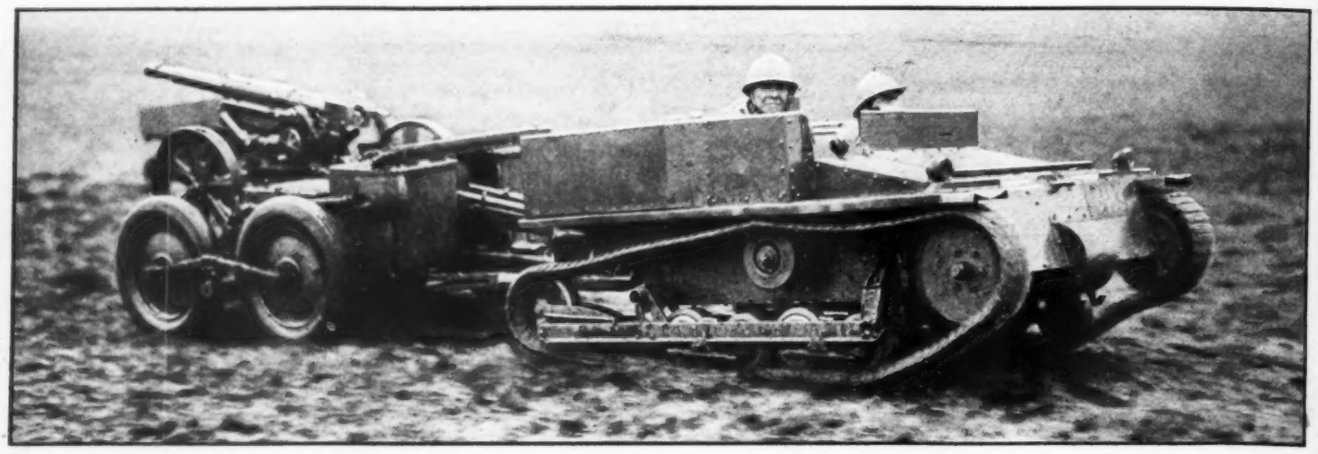


Close-up view of special fire-detecting wire which is strung behind moldings. Heat melts fusible core which expands, burns away the paraffined insulation, and sets off the alarm. At left, wire, like that seen above, detected the fire caused by hot flatiron and sounded the alarm so promptly that no more damage than picture shows was done by blaze

Everything in the record is planned for its psychological effect. The music is selected for its marching rhythm. The siren is used to accustom the children to it in drills so that they will not be frightened by the real thing.

Meanwhile, the fire department is notified automatically by the electric system. Arriving firemen find red arrows in the hall pointing toward the blaze.

Numerous installations have been made of the fire-detecting wire. With the addition of the sound apparatus, developed by Western Electric engineers, a real mechanical hero is provided that may be depended upon to prevent a panic.



BELGIUM'S TANK DESTROYER TOWS GUN ON WHEELS

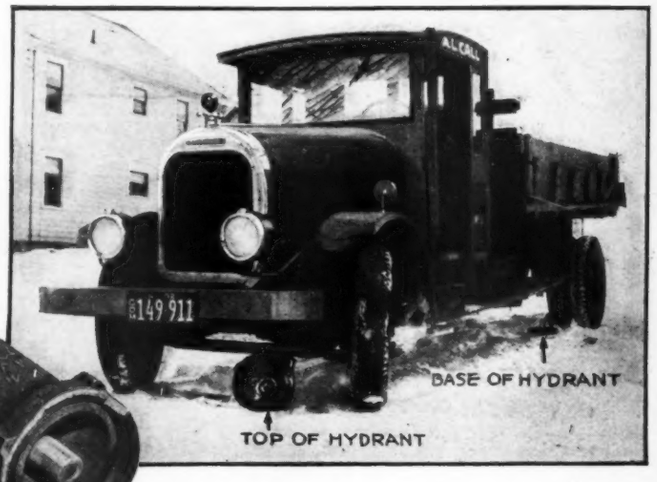
NEWEST weapon against the formidable tank of army warfare is the "tank destroyer," of which the first recently went into service for the Belgian Army. This motorized unit includes a powerful field gun, mounted on a four-wheeled towing carriage, and a speedy tractor of endless-tread type to whirl it into action. Army experts believe that a fleet of these swift "destroyers" could set up their mobile artillery in time to repel a surprise advance of enemy tanks.

VIBRATING TABS HELP MUSICIAN'S FINGERS

AN ELECTRIC finger exerciser for musicians is the invention of a Portland, Ore., music teacher. When the fingers of either hand are laid upon four metal tabs and the current turned on, a motor vibrates the tabs and exercises the finger muscles. Players of any keyboard instrument are benefited by the treatment, according to the inventor. Their fingers become so supple that difficult musical passages are easy to perform.

HYDRANT BREAKS EASILY BUT PREVENTS FLOOD

When the driver of the truck at right struck the breakable hydrant, the only damage was to the replaceable breaking ring. A self-closing valve prevented damaging flood of water



Here is a close-up of breakable hydrant after being struck by truck. Note how breaking ring shattered off cleanly

AT FIRST glance the chief virtue of a new style of fire hydrant might seem a defect—for it is especially designed to break! But the designers have a good reason for their seeming folly. When an ordinary hydrant is smashed by a skidding truck or pleasure car, the collision may entail extensive repairs both to the hydrant and the pavement surrounding it. The new hydrant has a threaded "breaking ring" above ground, connecting the top with the below-ground section, which snaps off when struck a heavy blow. A new ring may be installed in a few minutes. It is even unnecessary to shut off the water pressure, since a self-closing valve in the hydrant inlet prevents flooding.

HANDY PENCIL HOLDS IODINE

FIRST aid for cuts and wounds is provided by an antiseptic pencil that may be carried in a pocket, handbag, or camping kit. Resembling a fountain pen, it holds a hundred drops of iodine. When the cap is removed and the antiseptic pencil is tapped lightly, a drop of antiseptic falls upon the wound, as shown in the photograph at right. The nozzle is removable for refilling.

CONCRETE ROAD LINES REPLACE PAINT STRIP

WHITE concrete center lines are being built into highways in New Jersey in place of painted strips. The six-inch ribbons of concrete, running down the center of the roads, will provide permanent markings—an improvement over painted lines which must be renewed frequently due to ravages of weather and traffic. Thus the concrete marking will prove economical.

Taxi on Pontoons Takes Passengers for Fast Joy Ride

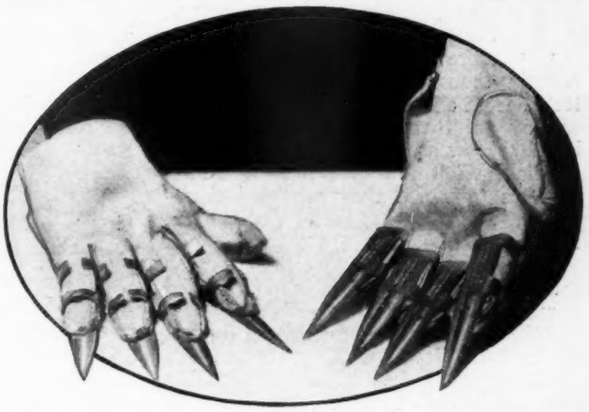
BY FITTING improvised pontoons to a discarded automobile, Isadore Cholfin, of Somerville, Mass., has created what he calls his "salt water taxi." A series of underwater propellers give the craft a speed of ten miles an hour through the smooth waters of the Charles River. The driver handles the controls in the same way as on dry land. Though one of the many signs scrawled on the side warns, "No swim? No ride!", Cholfin has no difficulty in finding passengers.

ROUND JAW GRIPS PIPE

A LOS ANGELES, Calif., inventor has applied for a patent on an ingenious pipe wrench. To make it grasp a pipe, the handle is twirled, advancing the circular inner jaw. The pivoted outer jaw has sufficient play to bite into the pipe when the wrench is turned. A thumb lever working against a spring releases the wrench from the pipe as shown in the photo.

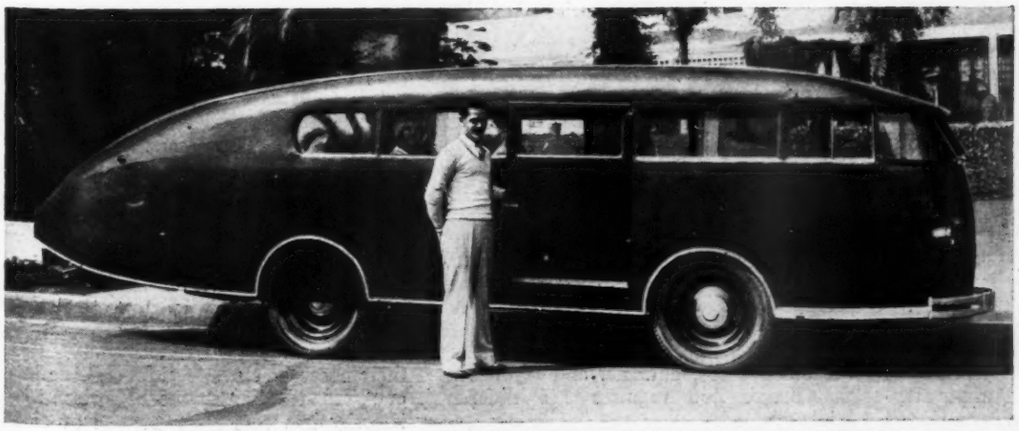
CLAWS ON GARDEN GLOVES SAVE HANDS

TO MAKE the task of weeding the garden less trying upon the hands, gloves with claws have made their appearance on the market. The claws are mounted one on each fingertip and riveted to the fabric of the glove. Their pointed tips speed up the work of removing rootlets and weeds from the flower bed or vegetable plot. The gloves appeal especially to women, since their use averts dirty fingers and spoiled manicures.



Steel claws are fastened securely to the fingertips of these garden gloves to speed the work and protect gardener's hands

BIG "MYSTERY BULLET" CAR HAS COMFORTS OF HOME



"Mystery bullet" car, streamlined for speed, a home on wheels in which are refrigerator, radio, bath, and sleeping accommodations for four persons, was built by California mechanic

A STREAMLINED house on wheels, called by its builder the "mystery bullet" car, has been constructed for cross-country jaunts by a Santa Monica, Calif., garage mechanic. Its interior contains bath facilities, davenport and lounge chairs, radio, electric refrigeration, a phonograph, and many other comforts. There are sleeping accommodations for four persons. The body is twenty-four feet long, six feet wide, and has a maximum height from floor to ceiling of sixty-seven inches.

How Jungle *Near Our*

Giant hippo shows the keeper his teeth as a preliminary to some needed dental work

Nubian giraffes, great hay eaters, need constant attention to keep them well. When "off their feed" they enjoy Bermuda onions. At the left, giant anteater that, in captivity, gets no ants but is fed milk, eggs, and beef that has been shredded

By JOHN E. LODGE

TWENTY-FIVE million people visit American zoos every year. Scattered from coast to coast, more than 130 zoological parks contain thousands of rare animals collected from all parts of the world.

How are these animals kept in good health? How are they treated when they get sick? What do they eat? How are the climates to which they are used reproduced? In fact, what goes on behind the scenes at a big zoo?

Those are frequent questions in the minds of visitors who see the animals on parade. To answer these queries and a host of others, I recently spent several days at Bronx Park, New York City, the zoo that holds more different species of wild life than any other on earth. Here, I learned what takes place when the gates are closed to the public, the way keepers care for rare specimens, how food is brought from far parts of the globe, and what scientific methods are being used to keep the wild creatures in captivity well and happy.

At the new reptile house recently opened at Washington, D. C., an elaborate humidifying, ventilating, and heating system has been installed. Thermostatically-controlled electric heaters at the back of every glass-fronted cage keep the snakes at the temperature that best suits them. This ranges from eighty degrees Fahrenheit for the diamond-back rattlers and cobras to seventy degrees for the bull snakes and the spreading adder. Glass roofs permit the sunlight to stream into the cages and when the sky is cloudy, ultra-violet lamps snap on, filling them with synthetic sunshine.

A major problem in every zoo is supplying the animals, birds, and reptiles with sufficient sunlight. It is almost as important as proper diet. At Bronx Park, a fifty-foot "sunshine island," circled by a water-filled moat and a concrete wall, has just been added to the equipment. In this solarium, more than 150 nonpoisonous reptiles will bask under the open sky during summer months.

In winter, four big ultra-violet lamps flood the jungle cages in the monkey house with artificial sunshine; 500-watt bulbs supply light and heat for the tropical lizards, and infra-red-ray lamps warm particularly sensitive birds and mammals.

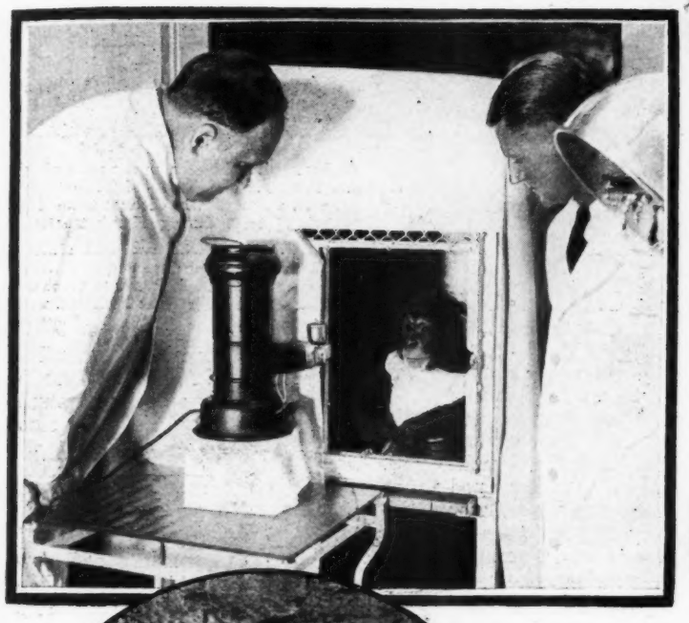
Providing the right food for all the animals in a zoological garden is in itself a tremendous task. Tidbits from all over the world—ant eggs from the Black Forest of Germany, gopher snakes from the prairies of Texas, dried flies from the shores of Africa's Lake Victoria Nyanza are part of the bill of fare. In fact, feeding the 3,000 birds, animals, and reptiles at the Bronx Zoo requires 124 different kinds of food.

The most expensive boarder there is "Alice," the Indian elephant. Her daily schedule calls for 150 pounds of hay, fifteen loaves of rye bread, and a pail of bran mash mixed with oats. Three times a week, in addition, there is a bushel of sliced carrots, beets, and potatoes.

"Peter the Great," her next door neighbor, ranks second. The meals of this 4,500-pound Nile hippopotamus include ninety pounds of hay, six loaves of rye bread, and a pail of mash each day, with a bushel of vegetables thrown in on Tuesdays, Thursdays, and Saturdays.

In the big storage barns at the park, timothy, clover, and alfalfa hay are packed in the hundred-ton lofts to meet the tastes of all the guests. Alice, the elephant, and Peter, the hippo, eat timothy but turn up their noses at clover. "Mogul," the great one-horned Indian rhinoceros, won't touch timothy but eats sixty pounds of clover a day. The antelopes like a little molasses mixed with their alfalfa. The tapir and the

Beasts *Live* *Big Cities*



Chimpanzee, upper left, has a cold and, shut in small compartment, is breathing a strong vapor from pine and boiling water. Above, tiger opens his mouth to show his tonsils

Polar bear diving into ice cold pool to escape first warm day

pygmy hippos favor straight clover, as does "Jack," the fifteen-foot Nubian giraffe, which eats twenty pounds a day from a manger bolted to the side of his stall ten feet from the ground.

At the Philadelphia, Pa., zoo recently, the $6,000 baby gorilla, "Bamboo," was provided with a special trained nurse who watched over his welfare and supervised his feeding. His meals cost about seventy-five cents a day and include two quarts of milk mixed with one raw egg, a few slices of bread and honey, zwieback, five bananas, an orange, prunes, grapes, and half a head of lettuce.

Feeding sea lions is a snap. Six times a week, they gulp down about twelve pounds of butterfish, and their diet never varies. The meal ticket for the five sea lions at the Bronx Park is $1,500 a year, representing more than 28,000 pounds of butterfish.

No one-course meals, however, will satisfy the inmates of the monkey house. They crave variety, and their menu is changed from day to day. Here is a typical week: Monday, bananas, boiled potatoes, apples. Tuesday, carrots, lettuce, bananas, cabbage. Wednesday, boiled rice, dates, raisins. Thursday, oranges, boiled potatoes, bananas. Friday, lettuce, carrots, bananas. Saturday, apples, bananas, oranges, boiled potatoes. Sunday, a few pieces of banana. The delicate South American monkeys have bone meal and codliver oil sprinkled over their food. Each evening, the big apes drink five or six cups full of eggnog before going to bed.

While zoo officials thus take utmost care to regulate the diet of their charges scientifically, the public has a different idea. Visitors try to feed the animals a weird array of tidbits from cigar butts and lollypops to golf balls and rubber dolls.

Not long ago, a cassowary, an ostrich-like bird from the Malay Archipelago, died suddenly at one American park. A post-mortem examination revealed it had swallowed a wooden spool, a rubber nipple, a small doll, seven metal pop-bottle caps, a ball, and a piece of stone an inch and a half across. It had managed these all right. But when a woman fed it a face-powder compact, that was too much.

At Cincinnati, Ohio, a $6,000 hippopotamus recently choked on an indoor baseball and died. One of the paradoxes among animals is the fact that the hippo has a relatively small throat attached to its cavernous mouth.

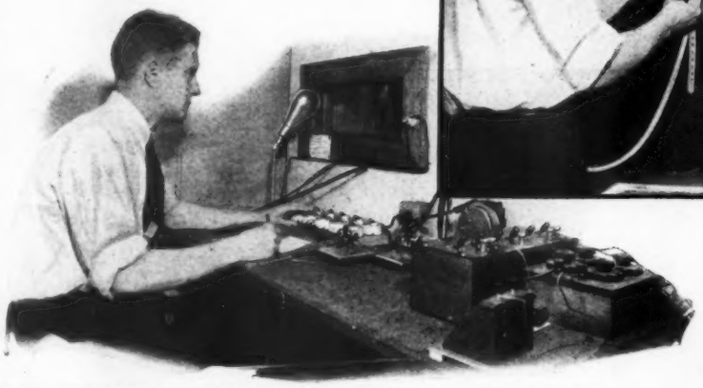
Only the other day, a keeper at the New York Zoo found one of the pygmy hippos apparently frothing at the mouth. Someone had fed it a big tube of toothpaste! The polar bear cubs once ate two dill pickles and another time tried to swallow a piece of auto tire someone shoved between the bars as a special delicacy. "Peter Boy," the red-muzzled drill, nearly died a few days ago from eating a hot-dog; and five handkerchiefs, snapped up under the impression they were butterfish, made one sea lion a very sick animal two summers ago.

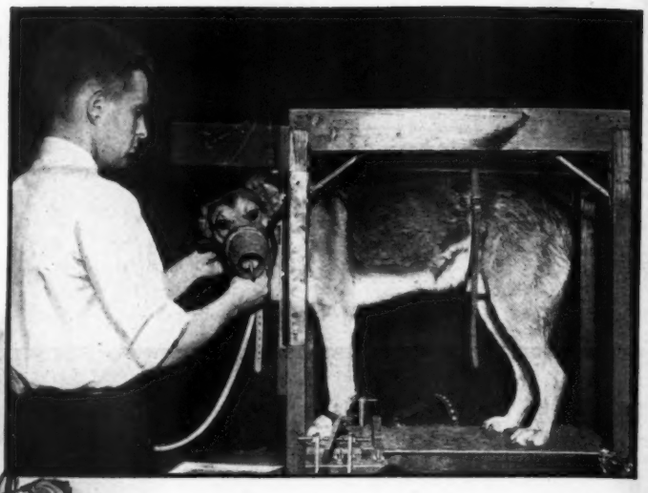
As many as 80,000 people visit the largest zoological parks on a single Sunday. Three million passed by the cages at New York last year. If only a small percentage of the visitors feed the animals peanuts or popcorn, trouble ensues. Incidently, the keepers tell me, popcorn is worse than peanuts. When an animal fills up on popcorn and then *(Continued on page 104)*

X-RAY HELPS DOGS HEAR

WILL X-ray treatment improve the hearing of deaf persons? At the University of Illinois, experimenters have found that moderate, repeated exposure beneath an X-ray machine will double and even triple the hearing ability of dogs. Sounds for the before-and-after tests, were produced by a radio-like hookup. The dogs, standing near a loudspeaker, were trained to raise the right forepaw on hearing the sounds.

To teach each dog this sign language, it was placed in an especially designed rack with its left forefoot strapped and its right one in contact with an electric terminal. The trainer would sound a tuning fork, and a few seconds later apply a mild electric shock to the animal's right foot. The dog soon learned to raise its foot. In another training method, a stream of water, squirted upon the dog's nose, replaced the electric shock.

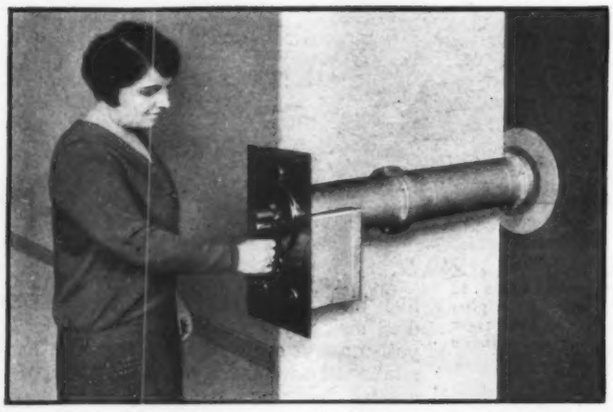




A tiny squirt of water on the nose of this dog taught it to raise its right foot when it heard a sound. Thus it was trained for "hearing" tests during X-ray treatment

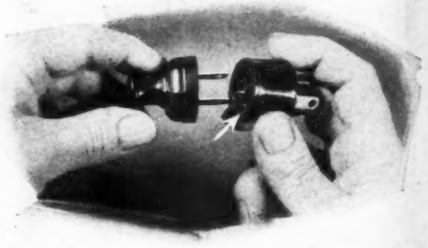
At left, operator who can send either a sound or electric shock to dog in training. Electric shock was also used to teach dog to raise foot and indicate he heard noise

AIR BLOWER BUILT INTO BANK VAULT



New bank vault ventilator, set up for demonstration, shows how an imprisoned employe could start it from the inside and thus escape

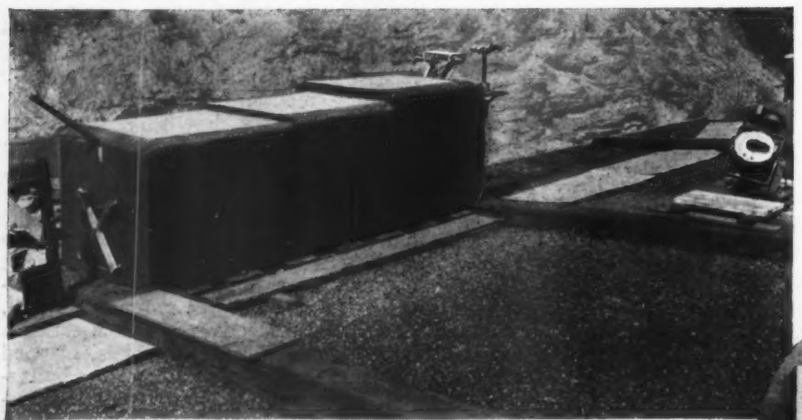
BANK employes need not fear accidental imprisonment and suffocation in a vault, when it is equipped with a new ventilator designed for such an emergency. Turning a switch lever from the inside opens the outer air ports and starts a motor blower, drawing in fresh air through the nickel-alloy cylinder in the vault wall. To talk to his rescuers, a prisoner may stop the blower and speak through the tube.



NEW SWIVEL PLUG WON'T TWIST ELECTRIC CORD

INSERTED in any wall outlet, a new swiveling "intermediate plug" is said to eliminate twisted appliance cords and the possibility of short circuits. Since it automatically lines itself up with the cord plug, it is especially useful in corners.

THEATER CONTINUES WARMING UP LONG AFTER SUN SETS



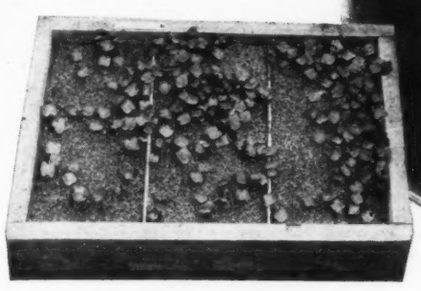
IF YOU go to an evening movie after a sultry day, and the theater seems just to have reached its hottest, don't doubt your senses. Probably you are right, according to experts of the American Society of Heating and Ventilating Engineers. By exposing to the sun a model theater with interchangeable walls of different materials, they measured the time required for heat to seep through a wall and make itself fully effective—a time lag that reaches more than six hours with a six-inch concrete wall. Thus a theater may still be warming up after the sun goes down. Designed to yield accurate data for planning air-cooling plants for theaters, the tests showed they must be three to ten times larger than usually estimated. With shiny aluminum paint on the outside of the building, however, less refrigeration would be needed.

Above, a box-like chamber, representing a theater, set up in the sun to measure heat that passes through wall. Instruments mounted outside the chamber record sun's intensity

At right, observer in laboratory watching electric gages connected with thermometers in theater during the test of wall material

Weed Seeds, Buried Thirty Years, Grow When Dug Up and Planted

A LONG drawn out experiment ended the other day at Arlington, Va., when experts of the U. S. Department of Agriculture dug up and planted seeds that had been buried several feet underground in pots of soil for thirty years. Among the seeds were barley, wheat, and an assorted collection of weeds. The test boxes were filled with the green shoots of bindweed, wild morning glory, ragweed, thistle, and other weeds and wild flowers. The test showed it is useless to try to kill weed seeds by plowing them under.



Upper right, digging up seeds buried for thirty years. Upper left, shaking the old seeds out prior to planting them. At left, bindweed that sprouted from the seed dormant for thirty years

CONTAINER FOR CAR HOLDS FAMILY WARDROBE

CLOTHING for the entire family may be carried in a car, without cluttering the rear seat or the running board with suitcases, by means of a new wardrobe container attached to the top. It is readily removable, may be hung in a closet and left packed if desired, and may be folded to half its size for easy handling. According to the maker, suits and dresses are kept neatly inside its folds without wrinkling. The device is also suitable for installation in airplanes.

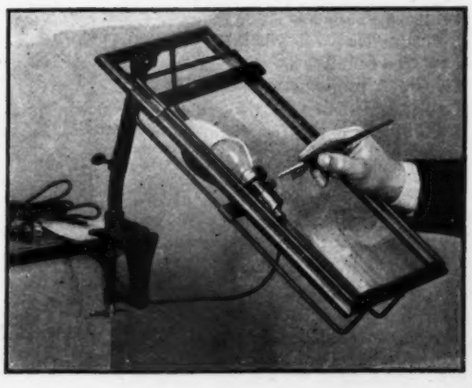
Above, family wardrobe container attached to car's roof. Left, container folded for handling

HAMMER HEAD LOCKS ON

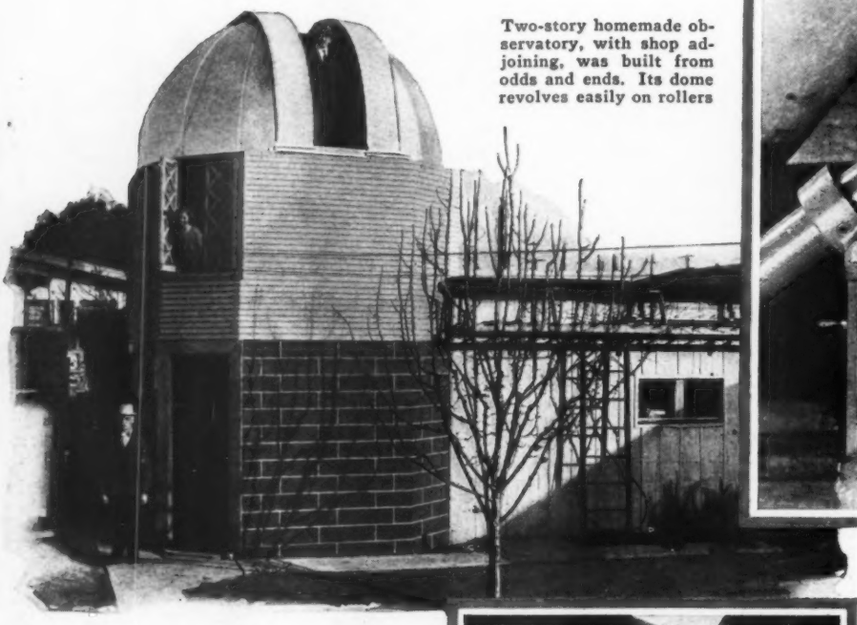
HAMMER heads won't fly off when they are fitted with a pair of locking strips devised by a Milwaukee, Wis., inventor. Notches are cut in the handle near the end, and the head is then slid on to the handle with a locking strip on each side. Spring prongs on the strips snap into the notches, and the head can't be taken off.

ILLUMINATED TRACING EASEL SPEEDS ART WORK

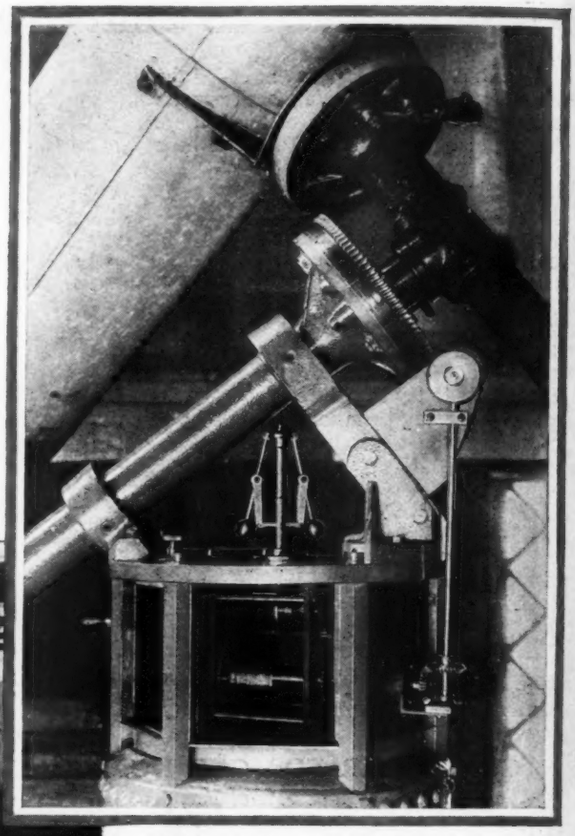
ANYONE who has ever tried to hold a picture or drawing against a window pane, in order to trace its outline upon another sheet with pen or pencil, will appreciate the convenience of a new illuminated tracing easel for art or office work. A picture laid upon its glass window is clearly seen through the tracing sheet by the light of a twenty-five-watt bulb beneath the glass. The adjustable stand is clamped to a convenient corner of a desk or table, and the easel may be swung out of the way when not in use without removing the clamp. Everything but the glass panel is made of metal.



Amateur's Home Built OBSERVATORY *Wins Astronomer's Praise*



Two-story homemade observatory, with shop adjoining, was built from odds and ends. Its dome revolves easily on rollers



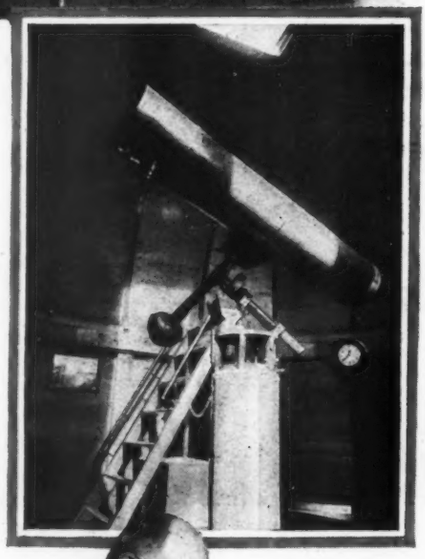
This mechanism, which controls the telescope, was put together largely of old car parts. It is inclosed in glass

Rare Skill Shown by Star Gazer Who Used Odds and Ends in His Telescope, Mounting, and Housing

THREE years ago, George F. Tauchmann of Berkeley, Calif., knew no more about the stars than the average schoolboy, nor did he have any means of studying them. Now he can range the skies intelligently and pick out and identify the better known stellar bodies. He does all this with his ten-and-one-half-inch reflecting telescope, set up in a two-story observatory with a regulation revolving top.

Telescope and the observatory were built by Tauchmann. He laid out and erected the building from foundation to dome, performing every part of the work himself—carpentering, sheet metal work and glazing—except for bending two pieces of two-inch angle iron into half circles to furnish the necessary stiffening for the metal dome, which is thirteen feet in diameter.

The telescope is built almost entirely of salvaged material. It is mounted on a tall, kitchen range boiler, inside of which hang the weights that drive the mechanism used for moving the telescope to compensate for the earth's rotation. To overcome vibration, the bottom of the tank is imbedded in concrete set in the ground. Both halves of a Ford rear axle housing are used for swinging the instrument—one as the declination axis, the other the polar axis. One still carries half the differential housing and this, filled with lead, serves as a counterweight. Old ships yielded port glasses which Tauchmann ground, polished and silvered. He prepared the glass from the simple, flat, transparent disk as it came from the ship's side, to the finished reflector.



HIS HOMEMADE REFLECTOR Below, Tauchmann grinding his own telescope reflector from a ship's old portlights. The glass is revolved by motor while he holds a heavy piece of metal against it. Above, inside the thirteen-foot observatory showing the complete assembly, with telescope swung at right angles to the opening

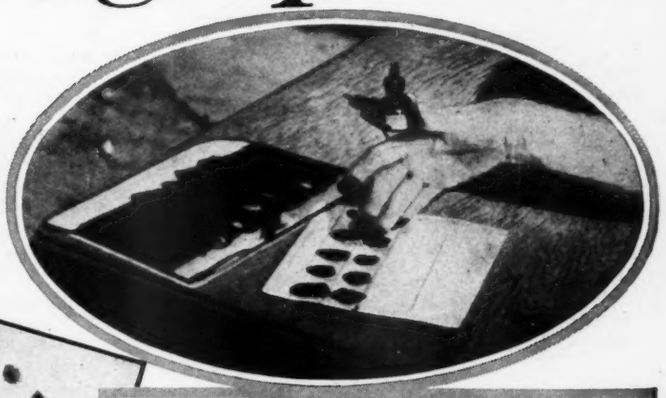
At present, Tauchmann is working on a twenty-two-inch reflector for a newer telescope, the construction of which will require all his spare time for a year or more. This will rank as one of the largest amateur-built instruments in the world. The present observatory is large enough to accommodate the new telescope, which will be completely new, including foundation, mounting and mechanism.

Tauchmann insists it is impossible to build anything like a good observatory or telescope without detailed plans. He followed this rule from the start, carefully planning every step on paper.

After a recent inspection of Tauchmann's plant, Dr. Robin Grant Aitken, director of Lick Observatory, said he had seen many home-built astronomical observatories, but this one more nearly approached professional quality than ony other he had examined.

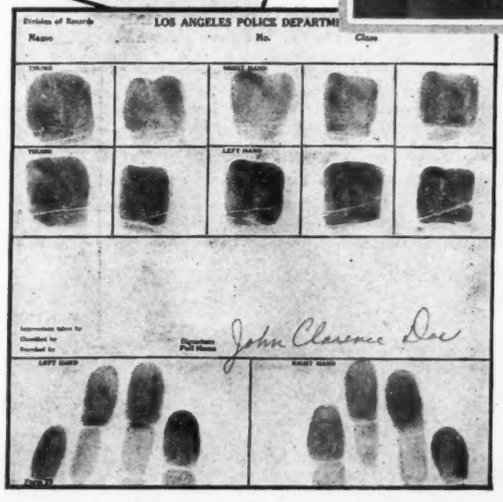
Protect Your Family by Recording Their *Fingerprints*

The new-born baby's foot is pressed against an ink pad and then held against a smooth finished piece of cardboard upon which the print of the foot is recorded as shown at the right. Then the mother's thumbprint is taken on the same card to complete the identification



To take your own fingerprints, a pane of glass is covered with a film of ink and against this the thumb and finger tips are pressed until covered with ink. Then print is made on cardboard as shown at the right

Ink film for staining finger tips can best be applied to pane of glass with a rubber roller. Distribute ink evenly and roll the fingers to get ink into the depressions



You can make a record of your own fingerprints similar to this one made by the Los Angeles police department by putting each print in a labeled square, rolling fingers to get clear impression

By STERLING GLEASON

KEEP a permanent record of the fingerprints of each member of your family.

This is the advice of police, hospital officials, and all others who know the truth about the thousands of mysterious disappearances, kidnapings, and suicides that occur annually. Various agencies will make such a record for a moderate fee. Police, in a number of cities, have volunteered to make a fingerprint record of children without charge for the parents who request it. No record is kept by the police, the impressions being turned over to the parents for their own use.

Such a record, along with a physical description and a photograph or two, can be kept among family keepsakes, and in case of emergency might furnish the clue that would restore a missing loved one to you, or frustrate the plans of criminals. If, for example, the fingerprints of the Lindbergh baby had been on file, his parents need never have paid $50,000 to impostors who did not have the child in their possession.

Many hospitals now take footprints of new-born babies, to prevent mix-up of the infants. The fingerprints of the mother are also recorded so as to prevent subsequent doubt as to the parentage.

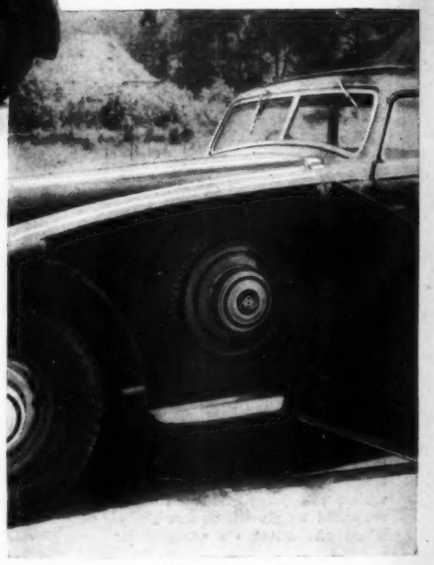
You can yourself easily make a fingerprint record in standard form that can be utilized by the identification experts. To do this, rule off ten squares on a smooth-surfaced card. Printer's ink should be used to make the impressions, although smooth paint, dried until it is tacky, will do. If a rubber roller is available, rub it with ink, then roll it across a pane of glass, leaving a black film upon the surface. Or, simply apply the film with a cloth.

Next, ink the fingers by pressing them down upon the glass, and transfer an impression to the card, placing the print of each finger in a separate square and labeling it. In taking the impressions, press the finger hard against the card and roll it slightly to each side to get a complete pattern of all the tiny ridges. Do not, however, allow the finger to slip and blur. Next, bunch the fingers and make a complete print of the fingers of each hand.

On the back of the card may be attached a pair of photographs, preferably a front and side view, and if desired, a pair of footprints. Other data which should be included are height, weight, color of hair and eyes, date of birth, build, complexion, any scars or identifying marks, and a specimen of the handwriting or signature. Stored away in a safe place, such a record may prove to be worth many times its cost.

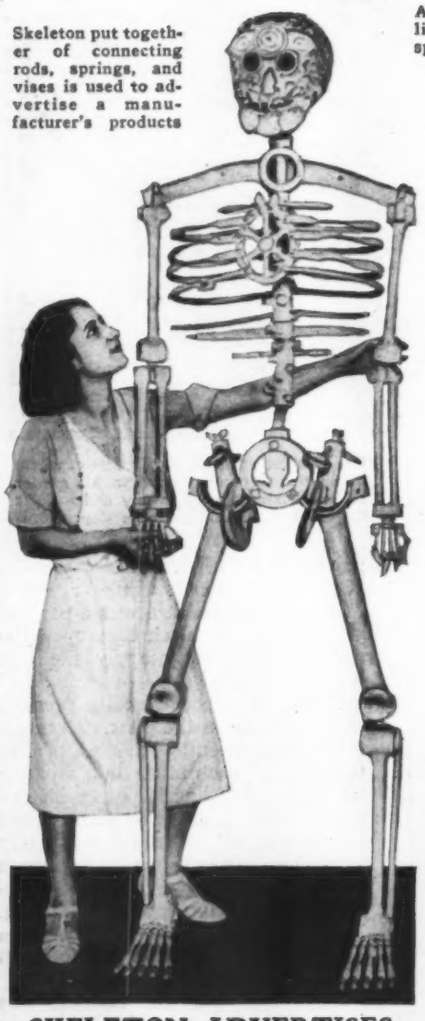
Streamlined Auto Designed by German Airplane Factory

DESIGNERS of the famous Junkers airplane firm of Germany have now turned their attention to the improvement of motor cars, with the result that advanced aerodynamic principles are built into a new automobile offered to the public. Its streamlined body, devoid of projections, is designed to minimize wind resistance and consequent fuel consumption. Fenders and running board melt into the smooth profile, and even the door handles are recessed. A compartment in the side of the hood houses a spare wheel, and the interior of the rear end provides space for luggage.



Aerodynamic principles are incorporated in streamlined car shown above. At right, compartment for spare wheel in side of hood, with door open for removal

Skeleton put together of connecting rods, springs, and vises is used to advertise a manufacturer's products



SKELETON ADVERTISES FACTORY'S PRODUCTS

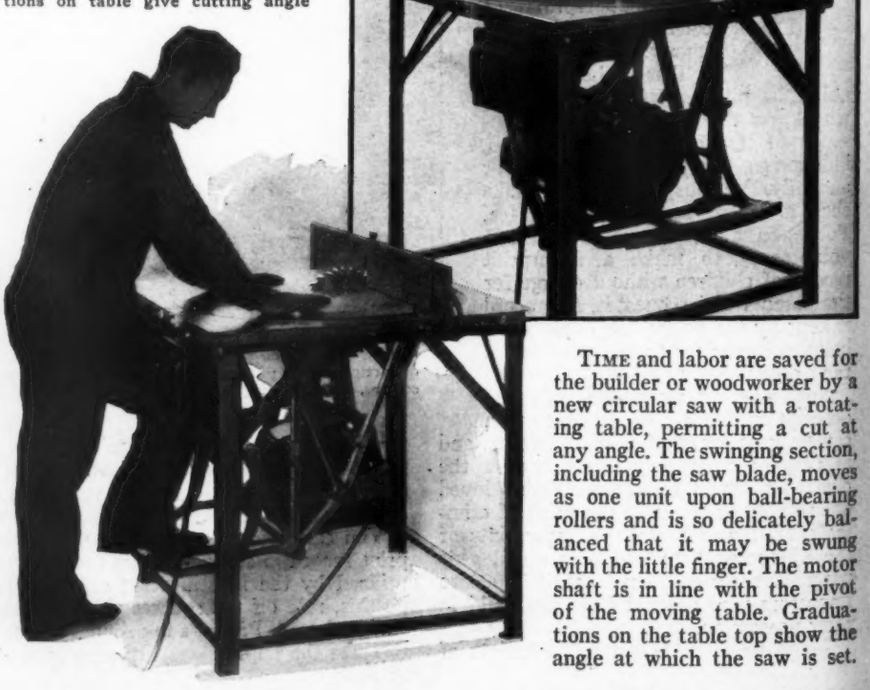
TO ADVERTISE his products in an unusual way, a Hartford, Conn., manufacturer constructed the giant "skeleton" pictured above and placed it on exhibit. Its bones are formed of connecting rods, springs, and vises, while the skull of the monster contains bobbins and rifle triggers.

ARTIFICIAL FOG SAVES GARDENS FROM FROST

FIGHTING frosts with artificial fog will be tried in Germany this fall, in the vicinity of Hamburg. It is expected vegetables will be protected by clouds of chemically-produced mist. Into drums of unslaked lime, dissolved sulphur trioxide will be allowed to drip when the farmer receives frost warnings from weather bureau headquarters. The reaction will produce the protecting cloud of vapor.

NEW CIRCULAR SAW CUTS AT ANY ANGLE

New circular saw, mounted on a rotating table, can cut a board at any angle. It is shown below as a crosscut saw while at right it is set for ripping. It may be used at any intermediate position and graduations on table give cutting angle

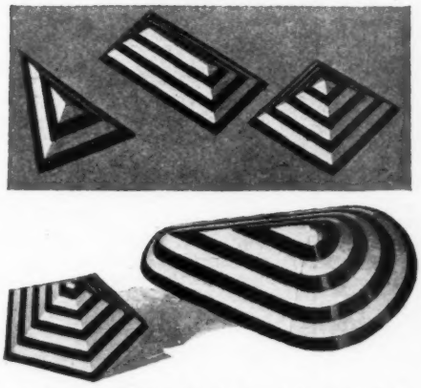


TIME and labor are saved for the builder or woodworker by a new circular saw with a rotating table, permitting a cut at any angle. The swinging section, including the saw blade, moves as one unit upon ball-bearing rollers and is so delicately balanced that it may be swung with the little finger. The motor shaft is in line with the pivot of the moving table. Graduations on the table top show the angle at which the saw is set.

SECRETS of STEEL *found in Sand Piles*

At top, two of the sand piles used to measure the forces that twist steel bars. Striped models, of wood, are made from sand piles for further study. Alternate layers of dark and light wood are useful in analyzing the distorting forces

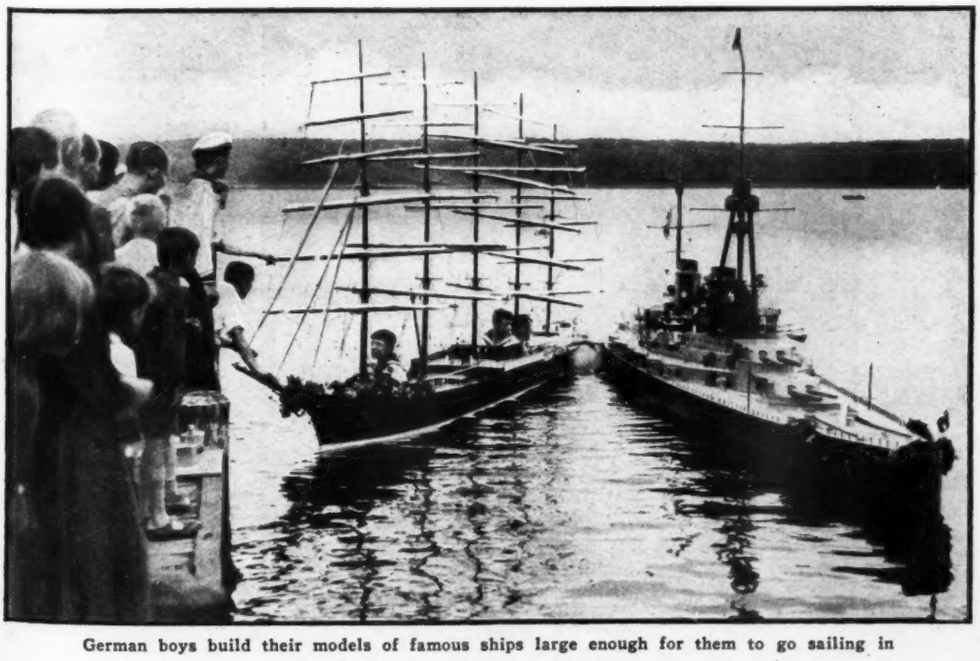
Dr. Nadai studies the behavior of steel with sand piles. At left is test chamber used to produce sample at right, in which white areas show where bar yields



LITTLE piles of sand are revealing hitherto unknown secrets of steel, in the hands of Dr. A. Nadai, Westinghouse research engineer. In particular, the sand models show the exact amount of force required to twist and deform steel bars of various cross sections. If a steel bar is twisted just a little, it will spring back unharmed when the pressure is released. More force gives it a permanent twist by exceeding the bar's limit of elasticity, and enough force will break it. Dr. Nadai measures the last two forces thus:

First he cuts a piece of cardboard exactly to the size and shape of the bar's cross section. Then he piles upon it as much fine, dry sand as will stay there without spilling over the edges. This heap takes a geometrical shape determined by the shape of the bar. The volume of this sand pile, Dr. Nadai demonstrates mathematically, is almost exactly in proportion to the amount of force required to give the bar a permanent twist.

Another experiment shows how the metal becomes plastic and "flows," under enough force, to take a new shape. A hollow glass shell is constructed in the shape of the sand pile, and coated on the inside with oil. Then a membrane of thin rubber, stretched flat, is sprinkled with powder and forced into it by air pressure, supplied by a tire pump, in an especially-constructed air chamber. White marks, adhering to the oiled shell where the powdered membrane has touched it, show the parts of the bar's cross section where the metal first yields or "flows." While the mathematics used in proof of this is complicated, the test itself is simple.



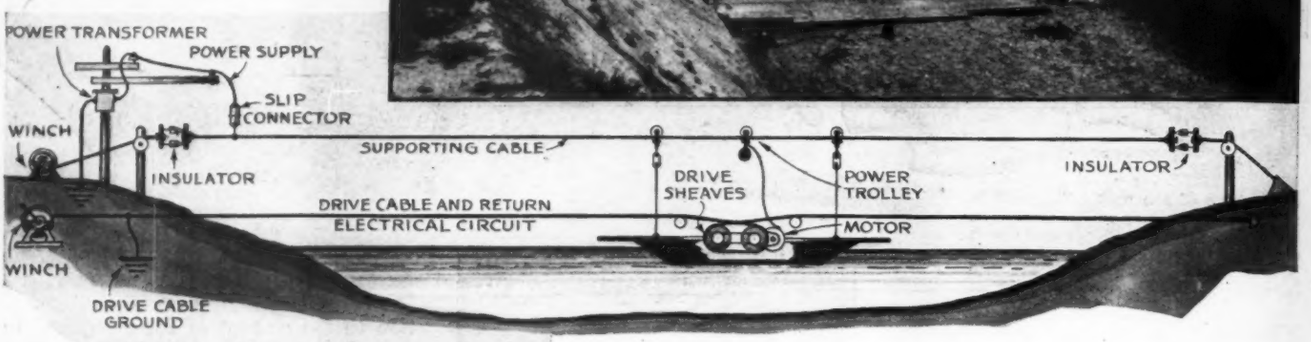
German boys build their models of famous ships large enough for them to go sailing in

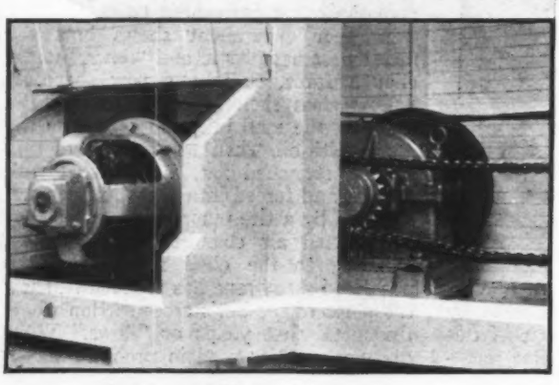
BUILDERS RIDE MODEL BOATS

SCHOOLBOYS of Potsdam, Germany, have gone in for ship-model-making on a larger scale than many of their American rivals. Under the direction of Max Bartsch, naval engineer, they are turning out seaworthy craft large enough to sail with their constructors aboard. The photograph reproduced here was taken just after the launching of two of the remarkable models—representing the cruiser *Hindenburg*, seen at the right in the picture, and the five-masted training frigate *Preussen*—in the river Hadel, near Potsdam. The miniature *Preussen* measures twenty feet from bow to stern. One of the boy model builders can be seen seated within the hull of the *Hindenburg*.

Ferryboat Crosses River on Trolley Wire

AN ELECTRIC ferryboat that runs on a trolley wire, believed the first of its kind, has just been tried out successfully in California. Carrying twelve automobiles at a time, the flat-bottomed craft plies back and forth across the Sacramento River at a speed of approximately 180 feet a minute. It thus makes the crossing, loaded with twelve cars and passengers, in about two minutes. Its cost of operation is estimated at one-half that of an ordinary gasoline-engine ferry. The boat pulls itself across by one of the two trolley wires that form a complete circuit to carry current to the motor in the craft. Because the Sacramento River is a navigable stream, and the trolley cables must be dropped to the bed of the river to permit up and down traffic to pass, the engineers who designed the ferry were presented with an unusual problem. The wires must be bare for the trolley wheels to make contact with them, yet, when they were dropped into the water, they must not short-circuit. The difficulty was solved by insulating the "live" cable at each end and energizing it through a "slip" connector, a foolproof device which automatically shuts off the current when the cables are lowered into the stream by hand winches. The railroad commission of California has approved the installation of the strange ferry.





First electric ferry to run on trolley wire is shown at top moored to bank of Sacramento River. It carries 12 cars at a time. Diagram gives arrangement of cables that can be lowered into water without short-circuiting. At left, close-up of ferry's motor and one drive sheave

AUTOMATIC SHUTTER FOILS WINDOW THIEF

As the brick is hurled through this display window, the jointed iron shutter drops down and automatically locks itself to prevent theft

TO FOIL the thief who smashes a jewelry store window, a London, England, inventor has devised a shop window that is declared to be proof against looting. A jointed iron shutter is poised at the top of the window, on the inside. The moment the window is broken, the shutter is released. It drops across the window display and automatically locks at the bottom. At the same time an alarm is sounded. A demonstration of the new device was recently given when one of the shutters was installed in a shop. The inventor hurled a brick through the window. Promptly the shutter descended and locked.

GROWS STRAWBERRIES IN OLD AUTO TIRES

A STRAWBERRY garden has been made from discarded auto tires by a Pasadena, Calif., disabled war veteran. He stacked a dozen old tires, with six two-inch holes cut in the tread of each, and filled the inside with earth. Strawberry plants are put in the upper holes.

NEW ABRASIVE CLEANING STRIP IS FLEXIBLE

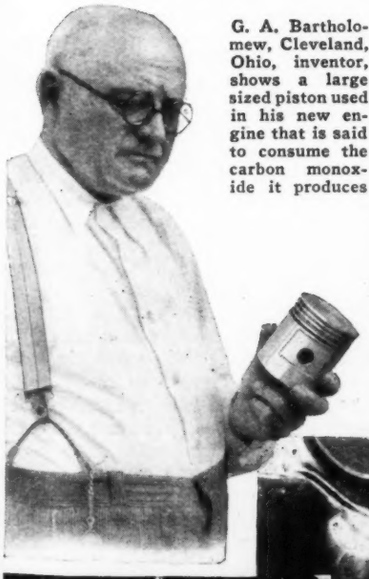
HANDY for cleaning the contact points of a car's ignition system, and for smoothing down the commutators of electric motors, is a new, flexible strip bearing an abrasive. Because of its thinness and flexibility, it gets into places where an ordinary grinding stone could not be used. Even the hardest metals, such as tungsten and platinum-iridium alloy, are easily filed. Since the flexible abrasive strip does not short-circuit an electric current, it may be used to dress a motor's commutator while it is running.

This abrasive strip, thin and flexible, can be used to clean in corners usually inaccessible

FLOODLIGHTS BRING MIDNIGHT GOLF

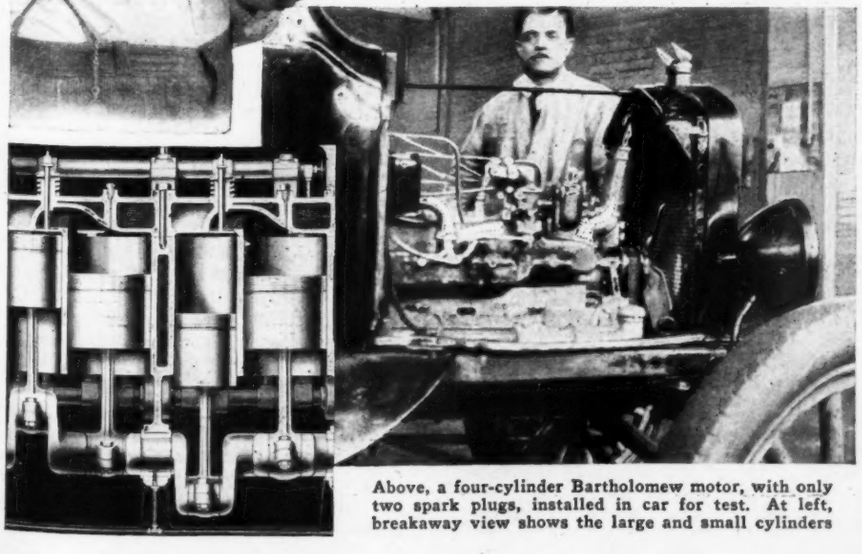
"FLOODLIGHT golf," played at night by the aid of powerful lamps, now provides recreation for many who cannot enjoy the sport by day. The photograph above shows the result of lighting a green at a San Francisco course, one of the first to initiate the new style. The installation comprises more than a hundred 1,500-watt lamps, and engineers say that there is twice as much light on the fairway and the rough as is ordinarily thrown on the average office desk.

ENGINE BURNS ITS CARBON MONOXIDE



G. A. Bartholomew, Cleveland, Ohio, inventor, shows a large sized piston used in his new engine that is said to consume the carbon monoxide it produces

ELIMINATION of deadly carbon monoxide from exhaust gases is claimed for a new gasoline engine of radical design. Half of the cylinders and pistons in the new engine are larger than the other half; and the number of spark plugs, valves, and intake and exhaust manifold openings is half that of an ordinary engine having the same number of cylinders. The inventor, G. A. Bartholomew, of Cleveland, Ohio, uses a principle similar to that of compound steam engines. Only the small cylinders have spark plugs for ignition. When the explosion in a small cylinder is almost over, the hot gases produced pass through a valve into the adjacent large cylinder, and are mixed with fresh air. Here they continue burning, using up all carbon monoxide, and producing additional power with a reduction in fuel consumption.



Above, a four-cylinder Bartholomew motor, with only two spark plugs, installed in car for test. At left, breakaway view shows the large and small cylinders

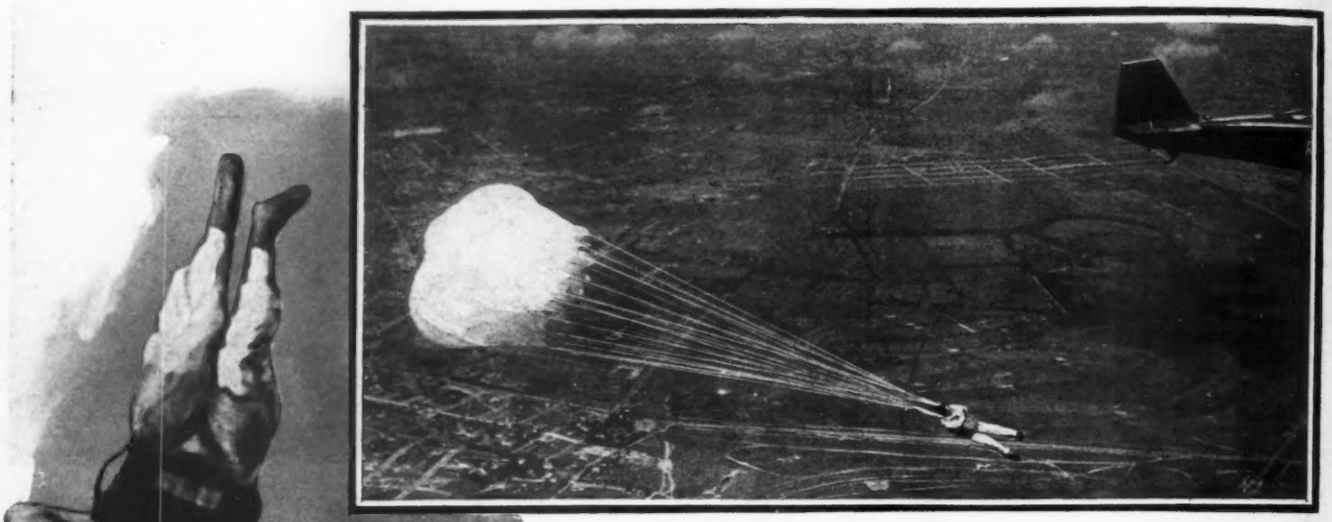
PORTABLE SEARCHLIGHT HAS HALF-MILE RANGE

A NEW portable searchlight, capable of lighting up an object a half-mile distant, has been placed on the market. It weighs thirteen pounds and draws its current from a storage battery of fifteen ampere-hour capacity. The battery will keep the light burning steadily for seven hours.

OIL PENETRATES METAL

DISCOVERY that oil penetrates metal, instead of merely forming a clinging film on its surface as formerly supposed, may improve lubrication methods. According to two experts who recently reported this surprising fact, oil may be wiped from the surface of a bearing and a new film will soon appear.

OUT OF THE AIR



At left, remarkable picture of parachute jumper falling head first a couple of seconds after leaving his plane. Above, the 'chute is partially open and has already swung the falling man feet down

Leaving a plane for a parachute jump

All the Thrills of Leaping into Space from an Airplane Are Packed into This Article by RANDY ENSLOW, Veteran Pilot

IF EVER I meet a silkworm, I ought to tip my hat three times.

That is the number of occasions—once in moonlight over the Pennsylvania mountains, once above a railroad track in Indiana, and once in blinding fog over Georgia—that parachute silk has saved my life.

A big moon was tipping the treetops, one October night in 1925, when I took off from a little field near Hagerstown, Md., to fly a secondhand Curtiss "Oriole" to its owner at Rochester, N. Y. The ship had been sitting out in the weather for months. Its paint was mostly washed away and its canvas half rotten. When I climbed aboard, I buckled on my parachute.

Everything was going smoothly when I passed Bellefonte, Pa., where mail planes land. A few minutes later, two clusters of pin-point lights, marking the towns of Snow Shoe and Sugar Camp, slipped past under my wings and I headed out over eighty miles of bad mountain country to the north.

It was almost ten o'clock and I was only an hour from Rochester when, without warning, the ship gave a sickening drop. I peered out the right side of the cockpit. The trailing edge of the lower wing was flapping in the moonlight. The rear spar, probably weakened by dry rot, had snapped off at the fuselage. I cut the switch, flipped back the catch of my safety belt, and dove headfirst over the left side of the cockpit into space.

As soon as I was clear of the plane, I yanked the rip cord and the parachute opened. I was still 500 feet in the air when the ship crashed, half a mile away. A thirty-foot sheet of flame shot up from the wreck, tinging the trees and clearings with red. I landed in a little open space that had once been a potato patch. Cramming my 'chute into its pack, I started across the rough timberland in search of a farmhouse.

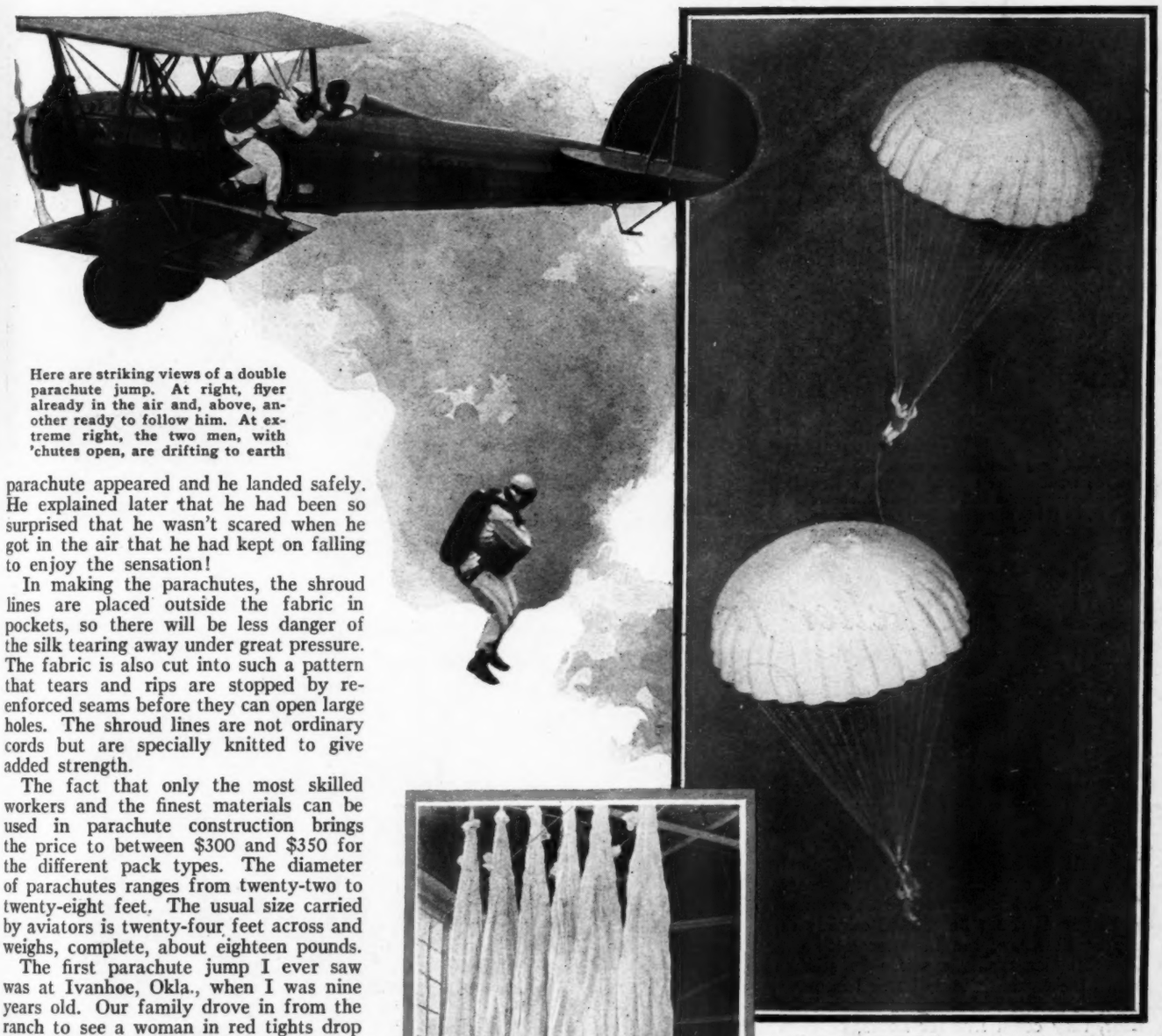
Half an hour later, I found a winding mountain road and followed it for miles until I came to a house in a valley. Here, an old man got out a battered runabout and took me to Towanda, Pa., where I caught a train for home.

In all, I have come down out of the sky in parachutes fifteen times, including three emergency jumps. People often ask me how it feels to fall hundreds of feet through space before the parachute opens. They want to know if the rush of air doesn't choke you and if the sensation isn't like falling in a nightmare.

On first jumps, you usually hold your breath until the 'chute pops open. Later you bail out breathing naturally. I have never heard of a jumper bothered in breathing by the rush of air, even though the velocity of the fall may reach two miles a minute. The sensation is hard to describe. It isn't anything like a nightmare. As you plunge downward, the air seems to buoy you up. The feeling is a little like falling on a feather bed.

I remember one rookie pilot who made his first jump from a plane I was flying. When he crawled out on the wing at 2,000 feet, his face was as solemn as a boiled owl's. But he was game and dove off. I went into a steep spiral to watch him fall. He dropped and dropped. I was in a cold sweat. Then, when he was only a black dot, the white mushroom of the

ON A BAG OF SILK



Here are striking views of a double parachute jump. At right, flyer already in the air and, above, another ready to follow him. At extreme right, the two men, with 'chutes open, are drifting to earth

parachute appeared and he landed safely. He explained later that he had been so surprised that he wasn't scared when he got in the air that he had kept on falling to enjoy the sensation!

In making the parachutes, the shroud lines are placed outside the fabric in pockets, so there will be less danger of the silk tearing away under great pressure. The fabric is also cut into such a pattern that tears and rips are stopped by reenforced seams before they can open large holes. The shroud lines are not ordinary cords but are specially knitted to give added strength.

The fact that only the most skilled workers and the finest materials can be used in parachute construction brings the price to between $300 and $350 for the different pack types. The diameter of parachutes ranges from twenty-two to twenty-eight feet. The usual size carried by aviators is twenty-four feet across and weighs, complete, about eighteen pounds.

The first parachute jump I ever saw was at Ivanhoe, Okla., when I was nine years old. Our family drove in from the ranch to see a woman in red tights drop from a hot air balloon. When she landed, the balloon sailed away over the prairie like the setting sun.

When Capt. Albert Berry made the first descent from an airplane at St. Louis in March, 1912, he had a big metal cone attached to a crosspiece in front of Tony Jannis' Benoist biplane. This held the silk and kept it from tangling. Later, the parachutes for airplane jumps were packed in big canvas bags.

I made my first jump with one of these bag type 'chutes near Deepwater, Mo., in 1921. My brother and I were barnstorming with a standard plane. The people were all going up for rides so we thought we would give them an extra treat. We packed the 'chute in the big canvas bag and tied it to the outer strut at the tip of the lower wing by means of ropes. Then we snapped the ends of the harness straps to a bracing wire to keep them from whipping and took off.

At 2,500 feet, I crawled out on the wing, unsnapped the straps, fastened them to my harness, and then swung down, dangling under the wing. The bag was closed with a laced cord and a bow knot. When I reached up and jerked the knot, the whole inside of the bag fell out and I dropped, the 'chute opening as I fell.

Before the parachutes are packed in their bags, they are hung up in a high ceilinged room and thoroughly inspected to be sure no defect may bring disaster in an emergency

Modern parachutes are compressed, after being carefully folded, into square or oblong packs of khaki canvas. They are worn in three different positions: strapped to the chest, the back, or, in most cases with aviators, in such a position that they form a cushion to sit on during flight. A "pilot 'chute," equipped with a spring so it pops out like a jack-in-the-box when the rip cord is pulled, helps drag the main parachute out of the pack so it opens in the quickest possible time after the ring is jerked.

My first emergency jump was probably the most amazing escape I have had in sixteen years of flying. It was all over in a few ticks *(Continued on page 101)*

That future wars may be fought with gas and bomb attacks from the sky, as suggested in this drawing, has led to the invention in France of the new gas shelter shown below. In it a family would be safe from gas for many hours

Germany, also fearing gas raids from the air, is training her soldiers and war dogs to wear gas masks. The photograph shows a dog, masked for safety, being held in the deadly fumes to accustom it to experience

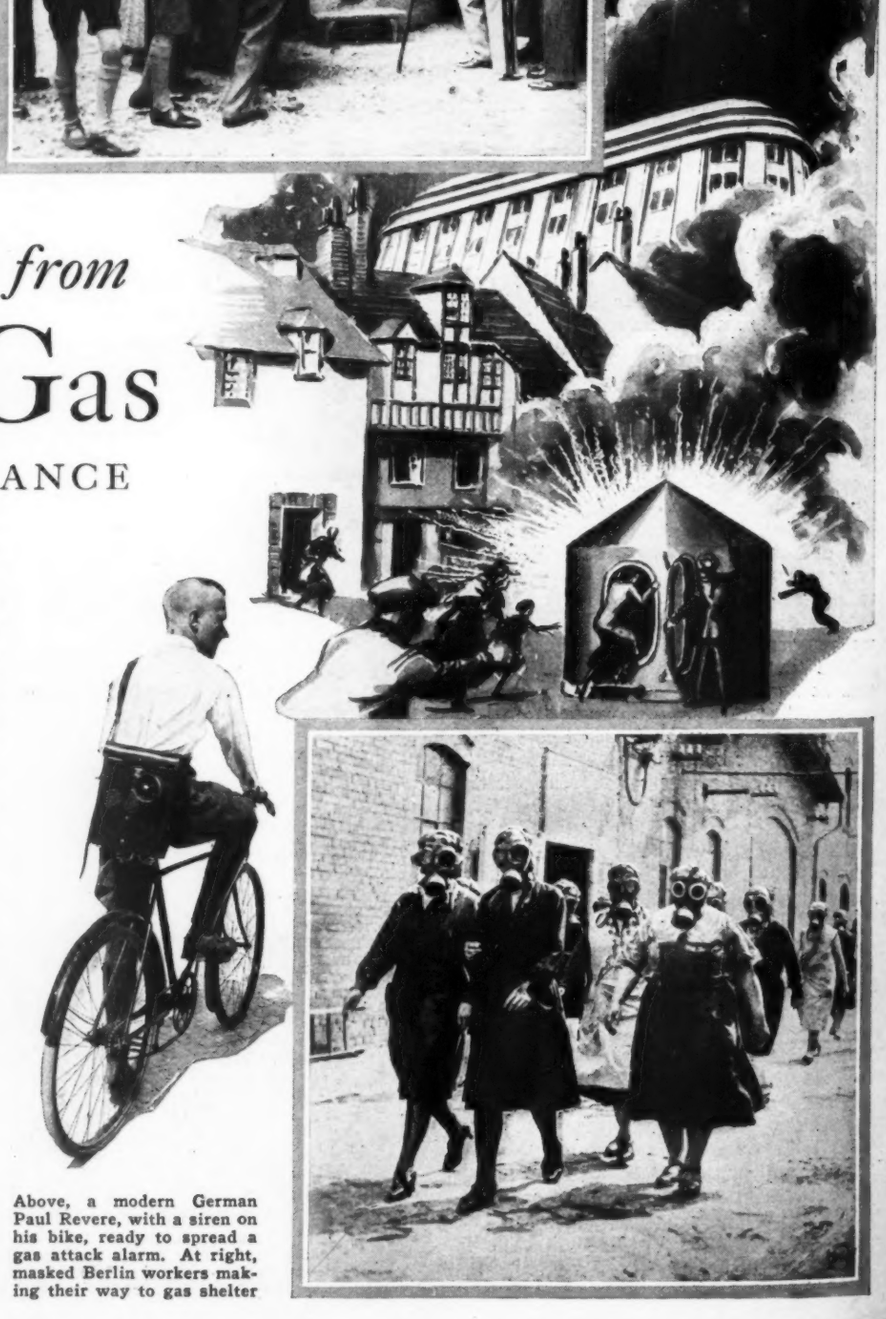
New Shelter from Poison Gas

TESTED IN FRANCE

AROUND a little house with a conical roof, exhibited in Paris the other day, a knot of excited Frenchmen gathered. It could be erected quickly in any small space, the inventor declared, for protection against a poison-gas attack. When the owner's family hurried into the concrete shelter and slammed the air-tight door, they could live for hours, or even days, sustained by oxygen apparatus.

Strange to American minds, the thought of a gas attack is no empty bogey to many Frenchmen. So seriously do they take it that gas masks have actually been placed on sale in French shops, and were advertised last winter as "ideal Christmas gifts!" Germany, meanwhile, has begun a national campaign to train the public in self-protection from gas raids. Russia is reported to require as many floors underground as above ground, when feasible, and rooms convertible into gasproof chambers, in newly erected buildings.

What has made continental Europe so "gas-minded?" As a French military observer points out, aviation's rapid strides now bring danger of air raids and gas bombs to cities far from battle fronts. If another war comes, noncombatants will be exposed to more terrible perils than ever before. Faced with such a menace, many European countries are making nation-wide plans for civilians' protection.



Above, a modern German Paul Revere, with a siren on his bike, ready to spread a gas attack alarm. At right, masked Berlin workers making their way to gas shelter

New War Tank Jumps Ditches

Running at sixty miles an hour, this new war tank leaped into the air, cleared a twelve-foot ditch, and landed right side up thirty-five feet from take-off

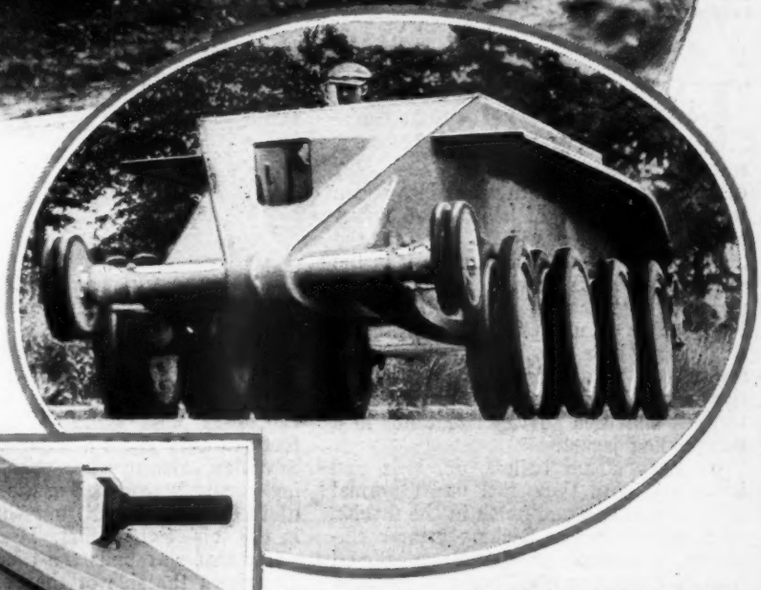
ROARING down a New Jersey field at a mile-a-minute clip, a few weeks ago, a four-ton machine of steel hurtled off an embankment into the air. It crashed to earth thirty-five feet from the take-off, right side up and unharmed by its spectacular leap. Three times repeated, for high Army officials, was this demonstration of a "jumping tank" that will vault trenches and shell-holes at full speed.

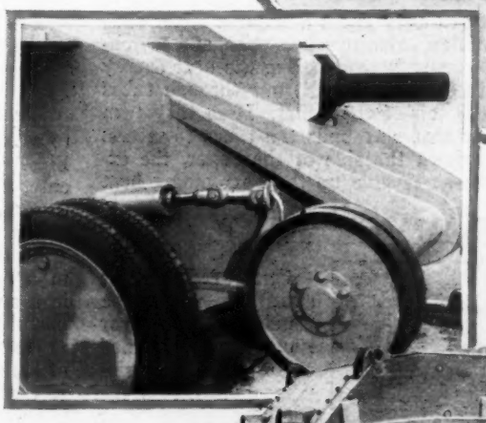
The new tank owes its leaping ability to powerful springs on which the wheels are mounted. Their exact construction is the secret of J. Walter Christie, builder of high-speed tanks for the U. S. Army and inventor of the new jumping tank. It is known, however, that the springs make the tank leap upward when it hits a bump at full speed, much as a springboard gives a diver a boost.

In actual combat the driver, crouching in a padded seat behind a steering wheel like that of a standard motor car, clears a trench by a fast take-off from a suitable raised spot. His skill in choosing the place of leaping, and his speed, determine the length of the jump. The springs absorb the terrific impact of landing.

Remarkable aside from its jumping, the new 1,000-horsepower tank is believed to be the fastest ever built. Stripped of its endless treads, it was clocked at 110 miles an hour. Three-inch guns serve as armament.

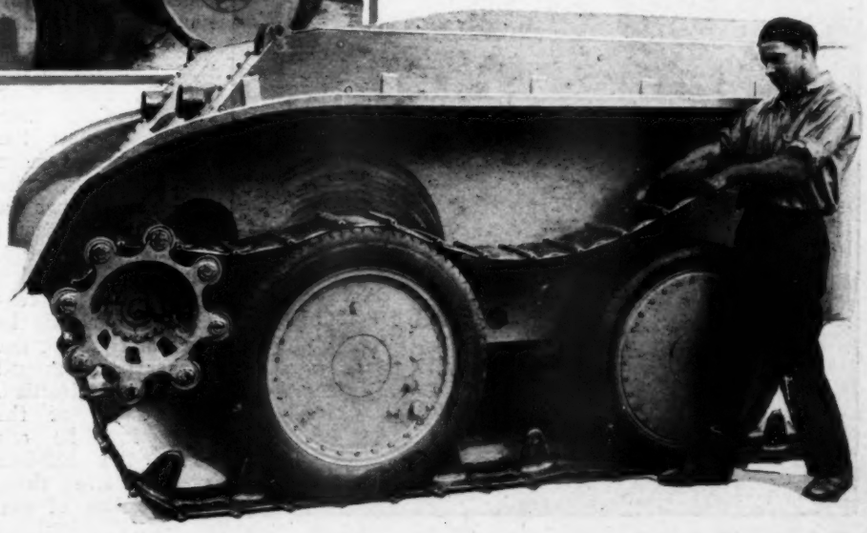
Soon Christie plans to fit his jumping tank to be carried from place to place by a large airplane. This innovation in warfare is a modification of his original plan to equip the tank with wings and propeller to fly it under its own power—a project that may be worked out later.



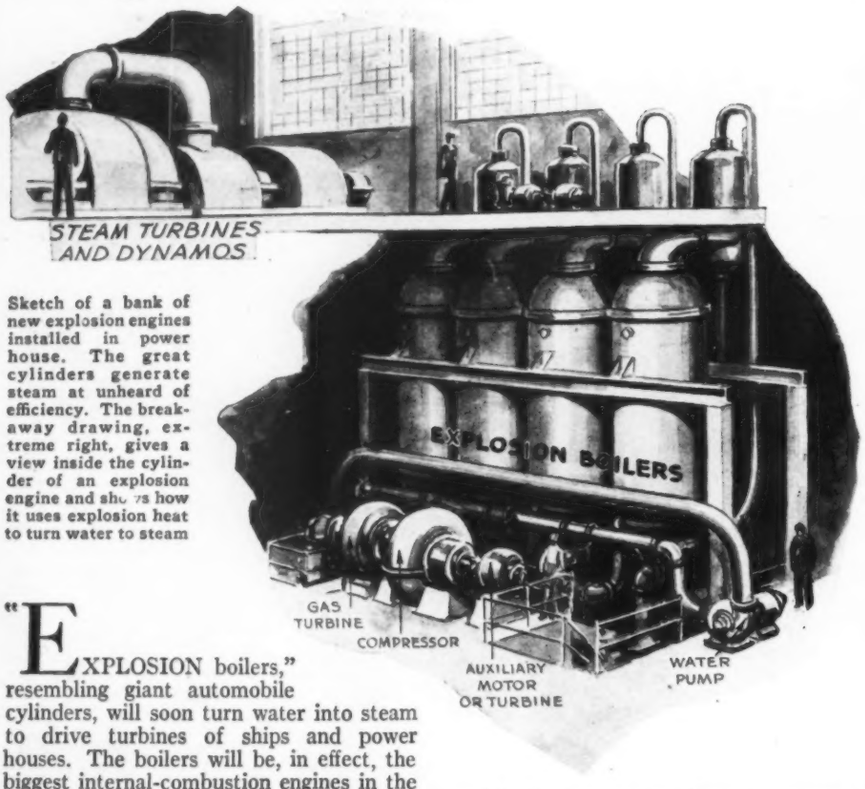


Below, removing the endless treads from the jumping tank to try its speed when running on rubber-tired wheels. Above, tank without treads ready for test on smooth road where it went 110 miles an hour

At left, view of front horizontal, incased spring on jumping tank. Details of the spring are a secret but it is the spring that gives tank its power to jump



Explosions Drive Giant Turbines

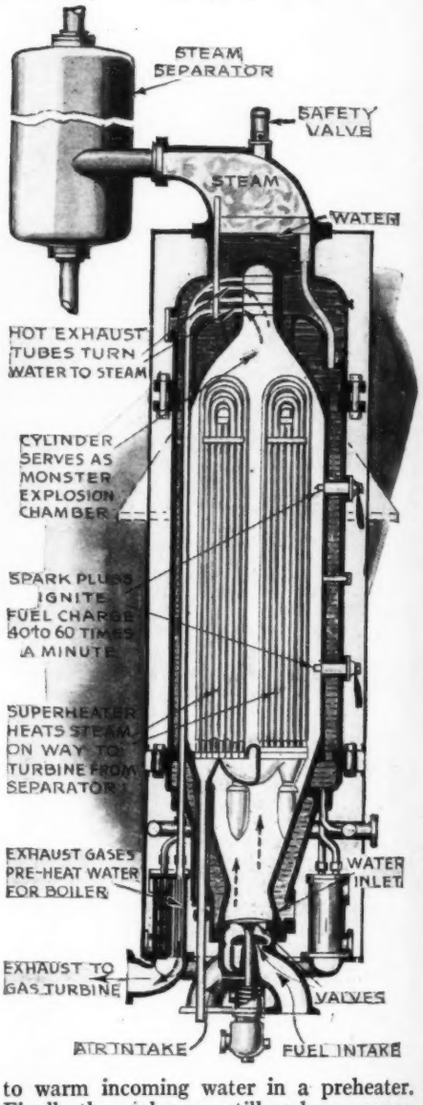


Sketch of a bank of new explosion engines installed in power house. The great cylinders generate steam at unheard of efficiency. The break-away drawing, extreme right, gives a view inside the cylinder of an explosion engine and shows how it uses explosion heat to turn water to steam

"EXPLOSION boilers," resembling giant automobile cylinders, will soon turn water into steam to drive turbines of ships and power houses. The boilers will be, in effect, the biggest internal-combustion engines in the world. Each one is large enough to swallow an entire automobile and more. Animated by oversize spark plugs, the cylinders chug-chug with a slow, measured beat, but no pistons move inside them. Instead, the concentrated heat of the explosion is trapped and used to vaporize water in a surrounding jacket.

Ordinary steam boilers, domestic and industrial, burn their fuel under normal atmospheric pressure much in the fashion of a kitchen range. Seeking greater efficiency, engineers of the Brown-Boveri firm of Switzerland, designers of turbines and other machinery for some of the world's largest power plants, conceived the idea of burning fuel under pressure and even exploding it.

A compressor forces the fuel—gas, oil, gasoline, or coal dust—into the mammoth combustion chamber. Inlet valves close, and spark plugs ignite the mixture from forty to sixty times a minute. After each explosion, exhaust valves open, and scorching exhaust gases, bearing the heat energy of the explosion, rush out through tubes in the top of the boiler. Here they turn water that surrounds the tubes to steam. Led down the side of the boiler, the exhaust gases give up their remaining heat to warm incoming water in a preheater. Finally the cool gases, still under pressure, enter a gas-driven turbine, rotated by their impact, which furnishes power for the compressor that feeds the boiler.


STEAM SEPARATOR
SAFETY VALVE
STEAM
WATER
HOT EXHAUST TUBES TURN WATER TO STEAM
CYLINDER SERVES AS MONSTER EXPLOSION CHAMBER
SPARK PLUGS IGNITE FUEL CHARGE 40 TO 60 TIMES A MINUTE
SUPERHEATER HEATS STEAM ON WAY TO TURBINE FROM SEPARATOR
EXHAUST GASES PRE-HEAT WATER FOR BOILER
WATER INLET
EXHAUST TO GAS TURBINE
VALVES
AIR INTAKE
FUEL INTAKE

Meanwhile, the steam is freed of water in a centrifugal separator and re-heated in a superheater coil within the explosion chamber of the boiler itself.

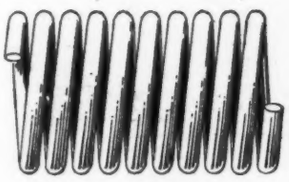
Just as a motorist regulates the speed of his car by stepping on the foot throttle, so the output of the new explosion boilers is controlled at will by regulating the rate at which fuel is supplied. For starting, an auxiliary motor or turbine operates the compressor, and it may be cut in again at any time if the turbine is insufficient.

Tests with an experimental explosion boiler at Baden, Switzerland, are reported to have shown almost unbelievable efficiency, indicating that it is possible, by this method, to extract *more than 100 percent* of the heat that the fuel theoretically contains. The apparent paradox is explained by the fact that the exhaust gases, first cooled and then allowed to expand, are finally discharged at a temperature actually lower than that of the surrounding air. This "heat pump" effect has never before been used in such a machine.

AUTO ON CABLES IS RIVER FERRY

ONE of America's strangest ferries, a standard motor car running on suspended cables, now carries passengers across the Pudding River near Barlow, Ore. Two strands support the car, which runs under its own power, while a third, through a pulley cradle, steadies the vehicle at the top. The only alteration made to the car consisted of removing the tires and placing flat rubber bands around the rims for traction. The owner of the ferry says he can make the 120-foot crossing, 1,760 times on a gallon of gas.

Can You Invent It?



HERE is a coil of round brass spring wire, open-wound, as shown in the diagram. How would you make use of this coil to produce a hollow flexible tube of the same diameter as the coil, without modifying the coil in any way? You are free to make any additions you wish, but the coil of wire, as shown, must be included in the finished tube. The solution of this interesting problem, which you are not likely to find especially difficult, will be published in the November issue of this magazine.

• •

LAST month you were shown a diagram illustrating the action of an ordinary typewriter. You were asked to modify the mechanism in such a manner that the clatter of keys on the platen roll would be eliminated so your invention would result in a noiseless machine. Here is one solution of this very interesting problem: When the key A is pressed downward, the force transmitted through bell-crank B, link C, and lever D acts upon the jointed type-bar E, straightening out the bend and pressing the type F into gradual but forceful contact with the platen roll G. This eliminates the hammer-blow which makes the ordinary typewriter so noisy. The platen G should be made of metal, instead of rubber, so the gradual "squeezing" between type and platen may make as good carbon copies as the hammer-blow stroke. You probably thought of other solutions to this practical problem but the one given here is the simplest and most satisfactory that could be given in a limited space.

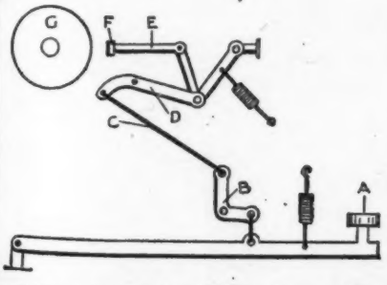


Diagram showing how to solve last month's problem regarding a noiseless typewriter

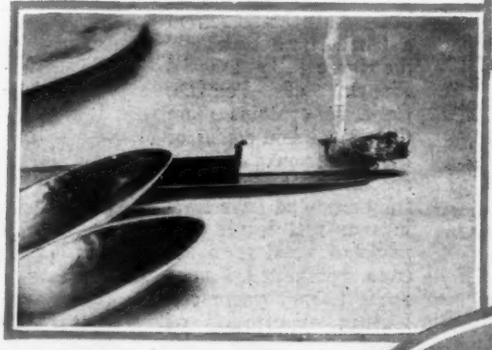
Baffling After-Dinner Stunts

CIGARS or cigarettes are practically all you need to perform a number of amusing and baffling stunts suitable for the relaxed period that follows a full dinner. Six of them are illustrated and explained on this page and only a couple of minutes' practice will be needed to enable you to do the most difficult of them. Once mastered you will get a lot of fun using them to dumfound your friends.

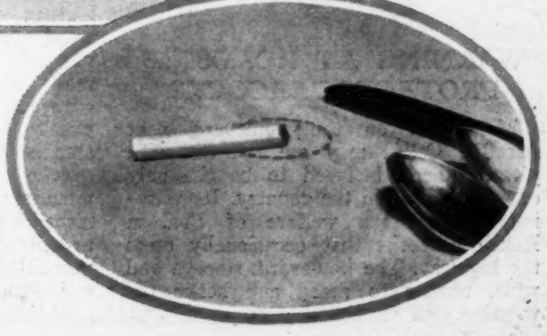
LIGHTING UP AT A DISTANCE. A match that is held six or eight inches below the end of a cigarette will light it as quickly as though it were held closely. It looks spooky but is based on the fact that the hottest part of a flame is invisible. If the match is moved slowly beneath the cigarette this hottest spot will easily be found

MAGIC CIGAR STICKS TO HAND The position of the thumb has nothing to do with the clinging nature of the cigar. A hooked pin is put beneath the band and the point clings to the hand. Smooth gestures then will not dislodge the cigar. When passed to guests for examination the cigar is quietly slipped off the pin

A VANISHING CIGAR BAND. The band is in plain sight on the cigar but a slight movement of thumb and fingers causes it to disappear. To do this trick, remove the band, cut it in two, and glue one-half back in place. Then the band vanishes as the cigar is turned



SMOKE WITH YOUR HANDS. Hold a cigarette as shown above with the hands tightly clasped. As the hands are slowly pressed together and then allowed to expand, the cigarette will puff exactly as though you held it between your lips and drew on it. The reason is that the movement of the hands creates a small vacuum and air is drawn through the cigarette. It is simple but it will startle and bewilder the guests

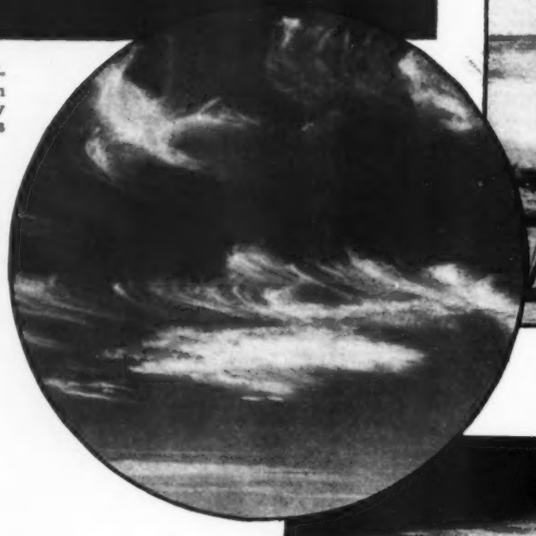


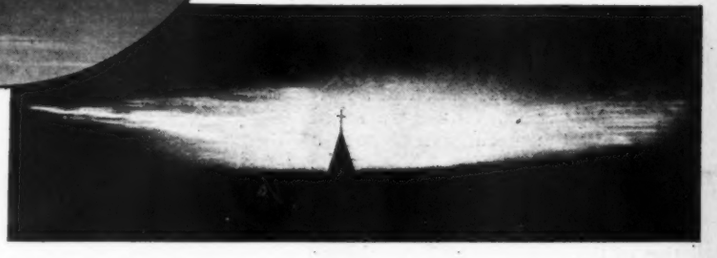
CIGARETTE GOES OUT. Cigarettes that burn until deliberately extinguished, will go out of their own accord if placed on the end of a knife as shown above. The metal in the knife absorbs heat so fast tobacco can't burn but your friends, not remembering this simple fact, will be astounded. A similar trick is illustrated at right. A burning cigarette is laid on table linen beneath which a half dollar has been placed. Metal keeps the cloth from burning but don't try it on your best linen

Find Mother-of-Pearl Clouds Fourteen Miles Above the Earth

Beautiful picture of "mother-of-pearl" clouds floating more than fourteen miles above Norway. They are at twice the height of cirrus

Professor Carl Störmer at one of his observatory stations near Oslo, Norway, from which he photographed "mother-of-pearl" clouds. Below, another kind of very high cloud, called noctilucent





Cirrus, composed of tiny ice crystals, float at a seven-mile elevation and were once thought to be the loftiest of all clouds

BEAUTIFUL, iridescent masses have just been discovered floating fourteen to seventeen miles above the earth, and named "mother-of-pearl clouds," adding a new fact to our knowledge of that little-known region, the stratosphere. Clouds showing rainbow tints have been observed before and some authorities believed they occurred at great heights. Recently Prof. Carl Störmer, Norwegian authority on auroras, accurately determined their altitude by the same method he uses to fix the height of northern light displays. This consists of taking simultaneous photographs against a starry background from two or more observatories and measuring the relative displacement in the pictures. Thus he showed mother-of-pearl clouds to be far above the level of cirrus, the feathery ice cloud sometimes described as the loftiest of all the clouds.

This discovery has heightened interest in another phenomenon, the "noctilucent" clouds seen during summer nights. They are bluish white and not iridescent, and are believed to be dust clouds. Early observations indicate a possible height for these clouds of fifty miles or more.

WARNING AT ROADSIDE PROTECTS PEACOCKS

MOTORISTS on the boulevard near Arcadia, Calif., may see the odd sign pictured here, believed to be the only one of its kind in the country. Its warning concerns the welfare of Baldwin Ranch peacocks that occasionally cross the highway. The boulevard, smooth and wide, tempts to speed and hence the warning sign seemed necessary.

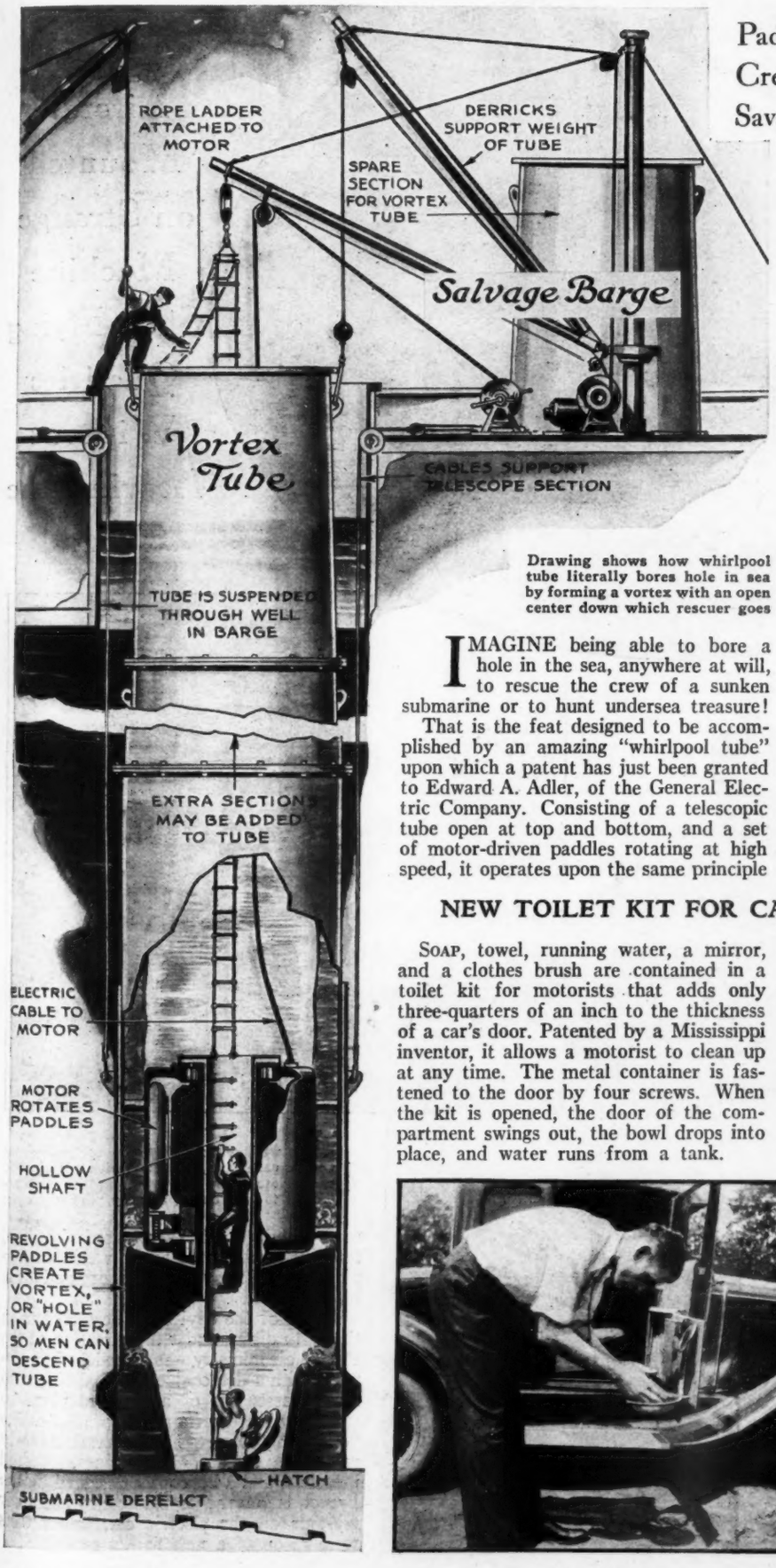
COPY 800 TREE LEAVES ON TABLE TOP

COMPLETE lessons in botany are embodied in a "nature table" designed by David French, of Pomona, Calif. It contains more than 800 inlaid copies of leaves from different species of trees, faithfully executed from tracings of real leaves and made of wood from the trees represented. French spent twenty years collecting specimens of wood, including such varieties as mountain mahogany, camphor, orange and nine kinds of eucalyptus. An old stump standing unnoticed for a quarter century on a mountain road in Eldorado County, Calif., furnished a sample of incense cedar. The fragments, assembled under French's direction, make an unusually handsome piece of furniture. It is embellished with appropriate inlaid quotations from Emerson, Whittier, and Browning.

Over 800 wooden copies of different leaves are inlaid in this table top

Whirlpool Tube *Puts Hole in Sea*

Paddles, Revolving at High Speed, Create Vortex Inside Which Life Savers Go to Disabled Submarine


ROPE LADDER ATTACHED TO MOTOR
DERRICKS SUPPORT WEIGHT OF TUBE
SPARE SECTION FOR VORTEX TUBE
Salvage Barge
Vortex Tube
CABLES SUPPORT TELESCOPE SECTION
TUBE IS SUSPENDED THROUGH WELL IN BARGE
EXTRA SECTIONS MAY BE ADDED TO TUBE
ELECTRIC CABLE TO MOTOR
MOTOR ROTATES PADDLES
HOLLOW SHAFT
REVOLVING PADDLES CREATE VORTEX, OR "HOLE" IN WATER, SO MEN CAN DESCEND TUBE
HATCH
SUBMARINE DERELICT

Drawing shows how whirlpool tube literally bores hole in sea by forming a vortex with an open center down which rescuer goes

IMAGINE being able to bore a hole in the sea, anywhere at will, to rescue the crew of a sunken submarine or to hunt undersea treasure!

That is the feat designed to be accomplished by an amazing "whirlpool tube" upon which a patent has just been granted to Edward A. Adler, of the General Electric Company. Consisting of a telescopic tube open at top and bottom, and a set of motor-driven paddles rotating at high speed, it operates upon the same principle that forms a hole in the water of your bathtub when the stopper is pulled.

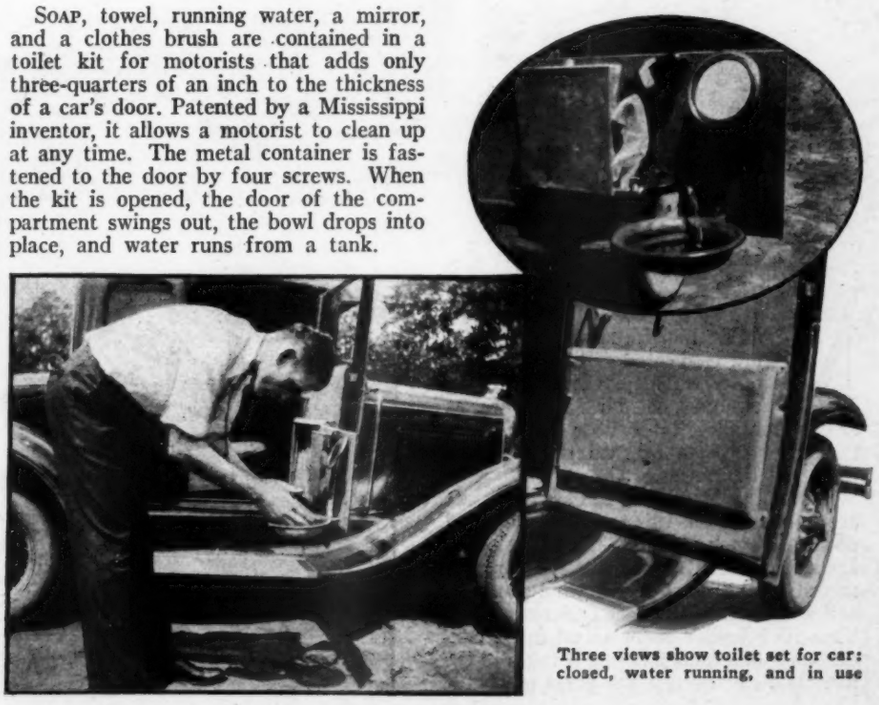
When the tube is lowered into the sea through a well in a salvage barge and the motor is started, Adler maintains, the entire column of water will be set whirling. Its own centrifugal force will draw the water to the sides of the tube, leaving a hole straight down the center. A salvager may descend a ladder through the hole, surrounded by churning water, without getting wet, and under normal atmospheric pressure. There will be no need of a diving suit.

The "whirlpool tube" differs from salvage devices previously built or proposed in that no effort will be made to keep it watertight, or to make an especially close-fitting joint with a derelict on which the tube's bottom rests. The force of the artificially created vortex will be more than adequate, Adler says, to expel incoming water and preserve the "manhole" in the tube. In fact, the only purpose of the cylindrical shell is to overcome the difficulty of controlling a vortex in open water.

Uses for this tube will be manifold, Adler foresees. Besides its more spectacular tasks in submarine rescues (as pictured by our artist on this month's cover) and the recovery of gold from sunken ships, it may be employed to collect oysters, edible seaweed, and other marine products from the bottom of the sea.

NEW TOILET KIT FOR CAR HAS RUNNING WATER

SOAP, towel, running water, a mirror, and a clothes brush are contained in a toilet kit for motorists that adds only three-quarters of an inch to the thickness of a car's door. Patented by a Mississippi inventor, it allows a motorist to clean up at any time. The metal container is fastened to the door by four screws. When the kit is opened, the door of the compartment swings out, the bowl drops into place, and water runs from a tank.

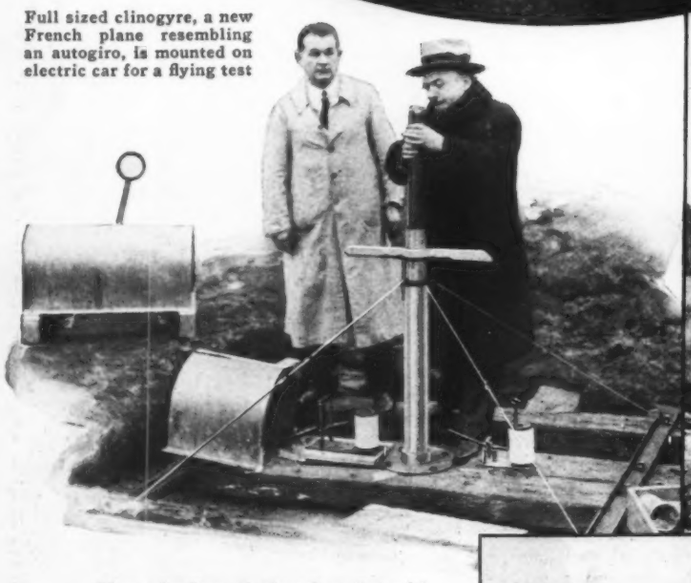


Three views show toilet set for car: closed, water running, and in use

Fast Electric Car Tests Planes

New Aircraft Mounted on Strange Machine Show Flying Qualities Without Leaving the Ground

Full sized clinogyre, a new French plane resembling an autogiro, is mounted on electric car for a flying test



Above, loading an aircraft rocket with six pounds of powder for test at French field. Right, watching the rocket burn

Plane, with detachable cabin to be lowered with a parachute, is tested with the electric car. Note cabin freed from plane and attached to the 'chute, already partially open

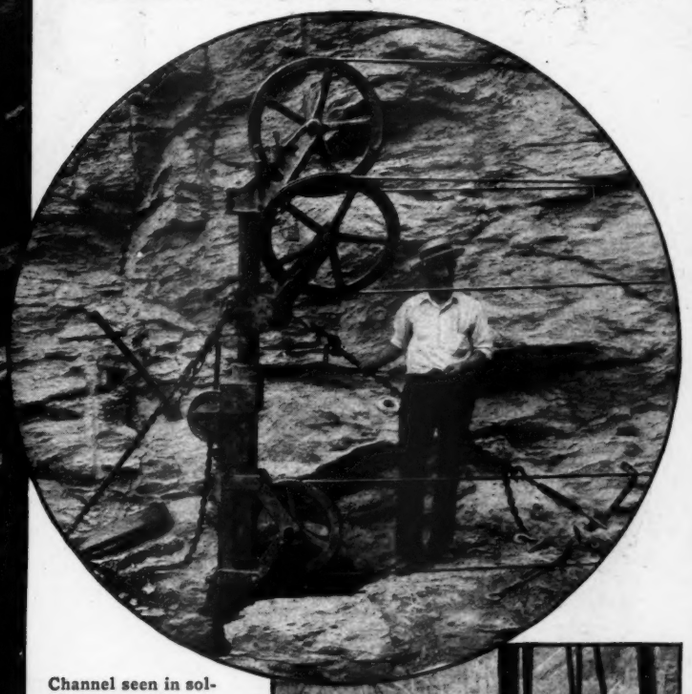
MANY a hopeful inventor's dreams are vindicated or blasted at one of aviation's strangest proving grounds, not far from Paris at St. Cyr, France, by a little electric car that runs along a railroad track with a third rail for power.

Diminutive models or full sized aircraft are mounted on this car and whisked down the track at mile-a-minute velocity. Instruments on the car make a constant record of the exact speed, wind pressure, and strain on the machine undergoing test. Thus its behavior under actual flying conditions is determined before it takes to the air. The electric test car plays much the same role as wind tunnels used elsewhere for tests of airworthiness, in which the airplane or model is held stationary and air is blown past it.

Latest of the devices to be tested upon the odd railway under the direction of the French air ministry was a model of an airplane with a detachable cabin, designed to lower passengers of a disabled plane to safety by means of a giant parachute. The "clinogyre," a new French craft strongly resembling the autogiro in appearance and principle, and a helicopter designed by the French engineer Damblanc, also had their try-outs on the electric car. Other tests were made of a new rocket motor.

Channel seen in solid rock, at left, was cut with wire saws. Note drill holes that helped install endless wires as saws

With wire saw, below, rock between shafts is cut away. The post maintains tension and guide wheels are lowered to follow the cut

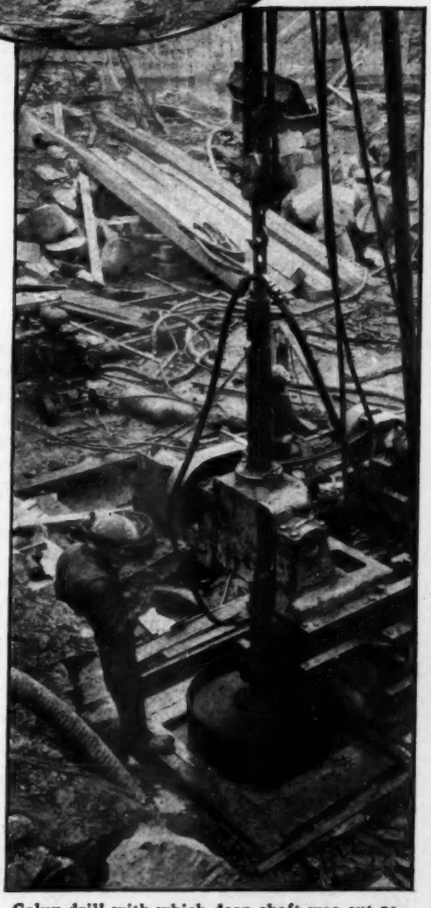


Odd Rock Test Makes Dam Safe

LOWERED into man-sized drill holes, experts recently passed upon the rock foundation for the proposed Prettyboy Dam site upon Gunpowder River to increase the water supply of Baltimore, Md. For this means of making a deep examination, shafts nearly sixty feet deep and a yard in diameter were sunk by a calyx drill. Geologists of Johns Hopkins University, who went down the holes, found the rock weakened by past geologic upheavals but able to support the proposed dam if care were taken not to jar the rock in excavating for the anchorage.

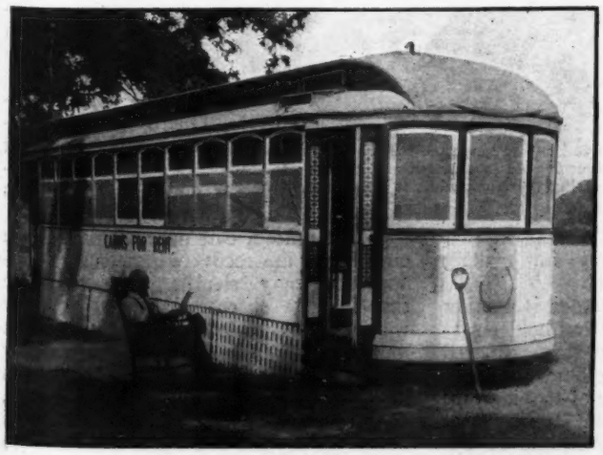
This ruled out blasting. Again the calyx drill was put into service. Its cutting tool is a steel barrel without a bottom, revolved rapidly by a motor-driven shaft. The lower edge of the barrel is slotted. Hard steel shot, fed into the slots, rub against the underlying rock, grinding a circular groove. From time to time the rock core in the tool is broken loose and lifted out. Thus fifty shafts were sunk.

"Wire saws" were then used to cut away the rock between the shafts. These are endless, motor-driven cables fed with water and sand, and held against the rock by tension posts set in pits. Guide wheels, over which the cable travels, may be screwed down to maintain cutting pressure. In this unusual fashion, the rock was cut without jarring the foundation.



Calyx drill with which deep shaft was cut so engineers could inspect Maryland dam site

TROLLEY CARS NOW TOURIST CABINS



Trolley car, with wheels removed, becomes attractive summer cabin

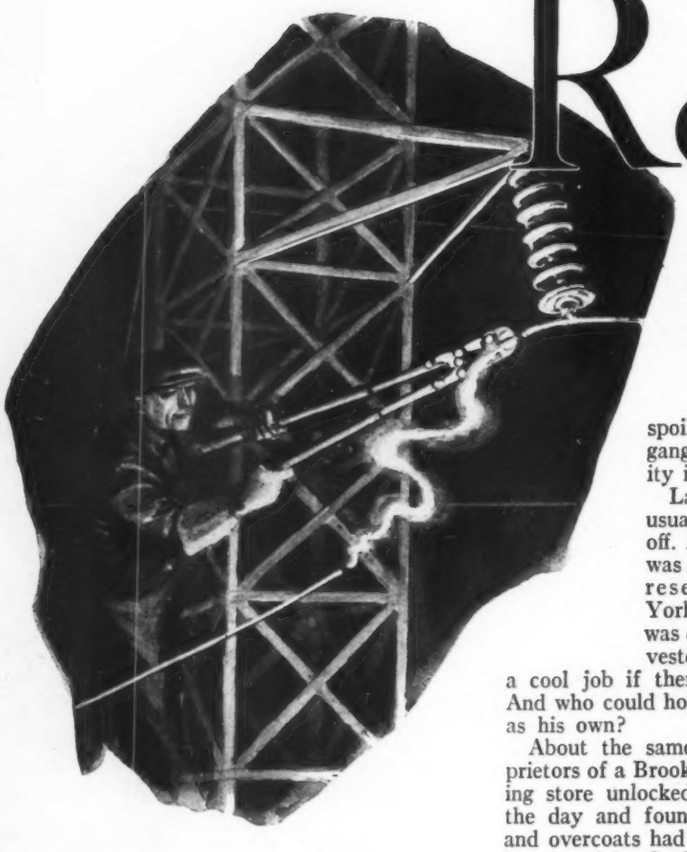
WHEN a trolley line between Carlisle and Mount Holly, Pa., discontinued operation, an enterprising hotel-keeper purchased the cars and made them into tourist cabins. Choosing an attractive site in a wooded grove between the two towns, he jacked up the trolley cars, removed the wheels and mechanical fittings, and attached neat trellises on both sides. A partition divided the interior of each car into two rooms. Beds, tables, washstands, and electric light completed the equipment.

TREES SUGGEST ARIZONA DROUGHT IN 300 YEARS

TO FORECAST rainy and dry seasons, engineers planning a big hydroelectric development on Salt River, Arizona, have been taking borings of tree trunks. Rings of growth, they say, have shown droughts in the years near 700, 1000, 1300, 1600, and 1900 A.D. The regularity of their recurrence forecasts a drought in 2200.

HOW THE MACHINE Robberies

Amazing Exploits of Organized Gangs Who Steal an Entire Railroad, Loot Museums, and Take Autos by Wholesale



Risking death at every instant, thieves cut loose and made off with 150 miles of copper wire that was at the time carrying a 144,000-volt current

ON A bright sunny morning, the manager of a Long Island, New York, golf club began his round of inspection. He whistled as he walked over the velvety fairway soon to be trod by light-hearted golfers.

Then the sun seemed to stop shining, at least for the manager.

His fifth green, his favorite, *where was it?*

He broke all records, golfing, running, and leaping, from that spot to his office. His language outdid anything uttered theretofore on that course as he phoned the nearest police station.

"Stole your *what?*" ejaculated the desk sergeant. "Stole your whole golf green? Well, I'll be . . . ."

Two detectives, after four days of work, found that lost green. That was quick work, for they had a large island to search, much of it covered with green. The lost fifth green was found neatly stacked in a cemetery miles from the golf course. The thrifty keeper had purchased the truckloads from some young men, he said. And that was that.

The 400 square yards of turf were duly replaced, but the mystery of how this remarkable theft was "pulled off" in a single night, without raising an alarm, remains unsolved. Only a well-organized band with plenty of men, trucks, guns, and nerve could have done it.

Many large thefts recently have been achieved without leaving a clue. From the "pick-up" men to the final "fences," and the shady financiers who sell the spoils and pay off the gang, organizing ability is evident.

Last winter two unusual jobs were pulled off. A quantity of ice was stolen from a city reservoir in New York State. The ice was expeditiously harvested and removed—a cool job if there ever was one. And who could hope to identify ice as his own?

About the same time, two proprietors of a Brooklyn, N. Y., clothing store unlocked their doors for the day and found that 300 suits and overcoats had been stolen during the night. Such things are hard to trace in a large city. They change hands quickly.

Following close on this theft, Boston thieves lifted half a million razor blades from a garage where they were stored awaiting shipment. The $30,000 worth of double-edged blades would supply the entire underworld with close shaves for a long time.

Sharpers along a different line caused an unexpected drought some months ago. In the dead of night they carted away a half-mile of lead pipe from the Enfield, Mass., water system. Many were deprived of water, and one can imagine their amazement as well as indignation. We expect water pipes to "stay put."

In connection with water, the report of a queer theft comes from Chicago, Ill. A man in that city was arrested recently for making away with 125 bathtubs!

A million barrels of crude oil is another item on this list of bigger and bolder robberies. Not long ago, Texas rangers placed a dozen men under arrest in the East Texas oil field on a charge of tapping pipe lines from five wells and stealing that amount of crude oil. By means of by-passes, or pipes leading around the flow-recording meters, they had obtained the oil over a period of more than seven months and shipped it to refineries without being detected.

Two million wasps formed the strange loot of thieves in another large scale robbery in California. The insects, known as gall wasps, were stolen from the fig ranch of Dr. H. C. Moore, near Merced. These insects, which produce balls on the leaves of oak trees, are bred in large numbers for use in the fig orchards where, in laying their eggs, they fertilize the blossoms by carrying pollen from flower to flower.

For sheer nerve it would be difficult to outrival the "live-wire" thieves of Michigan—the state that produces two-thirds of those swift vehicles which make wholesale robbery possible. Last October officials of the Consumers Power Company were simply astonished when told that 150 miles of copper wire had vanished from the high-tension lines between Grand Rapids and Marshall!

The lines at the time were carrying a heavy load of current. The robbers must have climbed the steel towers, risking instant death, to cut loose the heavy wires. In some unexplained way, they side-stepped the 144,000-volt electrocution that awaited them and removed sixteen tons of copper wire.

Forced out of his truck loaded with silk, the driver leaped into a taxi and gave chase, recovering the truck when it crashed into a car

The theft, unique in the power world, must have caused the owners of the world's greatest diamond mines, in South Africa, to wonder just how effective their electrified barbed-wire entanglements would be against such modern Big Business robbers.

Stealing motor cars does not pay. Three out of four are recovered, often by insurance company sleuths. But wholesale thieves have succeeded in getting away with whole truckloads of valuables. Not long ago a large truck, loaded with nearly $5,000 worth of motor accessories, was held up by armed men near Roselle Park, N. J. The driver and helper were forced into a sedan, and two masked men drove the loaded truck away.

AGE HAS LED TO *on a Gigantic Scale*

By
ORVILLE H. KNEEN

New Jersey bandits kidnaped the driver and helper of a silk-laden truck, tied them to trees, and escaped

Last year, in a raid on New York's garment center, a truckload of clothes worth $20,000 was driven away. Two of the robbers were captured, but the driver got away with the loot. In another holdup $22,000 worth of cigarettes were taken. Trucks played their part when eight men stole eight tons of peanuts from a storage house in East Albany, Ga., a short time ago.

An attempted truck robbery failed when thieves forced a driver to turn over his truck loaded with $6,500 worth of silk. The driver leaped into a taxi and gave chase. The fleeing truck ran into a car and the robbers abandoned their haul. Three days later six bandits, with sub-machine guns and sawed-off shotguns, made away with $30,000 worth of silk, about 12,000 pounds. The driver and his helper put up no fight when they saw the battery of guns.

Soon after that coup, six gunmen got away with an even richer haul—$50,000 worth of silk—when New Jersey bandits kidnaped a driver and helper and tied them to trees. A large bridge party in New York was seriously upset when the driver of a truck hauling twenty dozen chairs and card tables for the bridge players came out of a coffee shop to find his truck stolen!

Returning from the theater, this Long Island couple found their 15-foot magnolia tree gone

Another unusual truck theft, at Montclair, N. J., nearly "stopped the show" for Princeton's male dramatic society, the "Triangle Club," last winter. Two hours before the performance was scheduled to start, the collegiate actors discovered that the truck containing all the costumes and make-up to be used in their musical comedy had been stolen from in front of the theater. At the insistence of the audience, however, they went on with the show, leading "ladies" singing in tweed suits and trousered "chorus girls" going through their steps!

Frequently in truck thefts neither machine nor valuables can be found. They vanish and the insurance company pays the losses.

Stealing a single automobile is no longer profitable, but taking a job lot is another matter. A patrolman in Newark, N. J., stopped on his beat to admire the bright new cars in a large showroom. When, some hours later, he again passed the windows, every car had vanished! Fifteen of them, the entire stock, had been removed, and the lock was unbroken. That would have been a good case for Sherlock Holmes himself.

European thieves are more discriminating in selecting their loot. Not long ago ten valuable paintings were stolen from a collector's office in England, along with rare Persian silk and woolen rugs, Flemish tapestries, and ivory carvings. Not a sound was heard during the robbery. At Vienna an arsenal was looted of museum pieces consisting of 200 golden crosses, an antique silver statue of an ox filled with ducats, and other treasures of great historical interest.

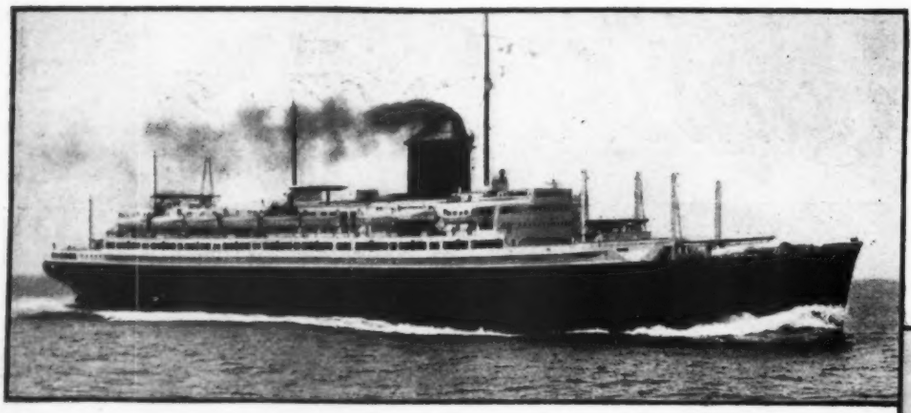
NO ONE has stolen a complete museum —as yet—but last spring Joseph A. Fuerstman, a lawyer of Newark, N. J., had almost that experience. He repaired his two and one-half story frame house, built a new fence around it, and offered it for rent. A month later when he went to look at it, he found only the cellar left.

Detectives found that families living on the street had torn down the house and fence piece by piece, using the lumber for firewood.

In Rockville Center, L. I., the other evening, when Fred Willard returned with his wife from a moving picture show and turned his car into the driveway, he could scarcely believe his eyes. A fifteen-foot flowering magnolia tree, which had been in full bloom on the lawn when they left for the theater, had disappeared. Neighbors recalled having seen a truck, apparently having motor trouble, stop in front of the house and a gang of men dismount. No attention was paid to them and the tree was not missed until the owner returned.

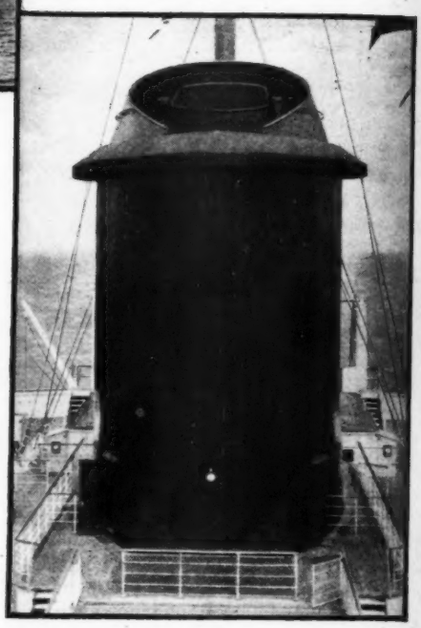
New Year's pranks are not always humorous. Last year a former motorman stole an empty trolley car from the barns, and ran it for seven miles. No doubt he got the kick of his life by passing up all the waiting passen- *(Continued on page 99)*

Smokestack Is Ventilator in New Liner



New French liner that has only one streamlined funnel which is also used as a ventilator, air being drawn in underneath the rim and forced into all parts of the big vessel

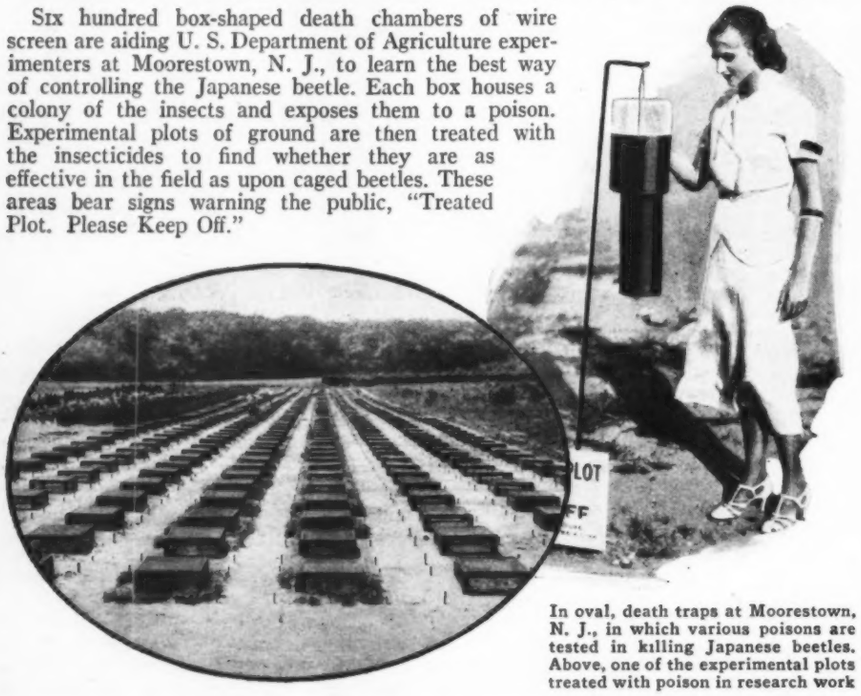
SMOKESTACK, ventilator, and grand staircase are combined in one on the new French liner *Champlain*. To reduce air resistance, the huge funnel is streamlined. An oval center passage carries the smoke away while fresh air, entering the funnel under a rim extending around the entire top, is used to ventilate the vessel. Below, the passage houses one of the grand staircases, passengers entering through two doors at the base of the funnel.



Close-up of double service funnel which, shaped like a big flatiron, holds stairway

KILL JAPANESE BEETLES IN NEW TRAPS

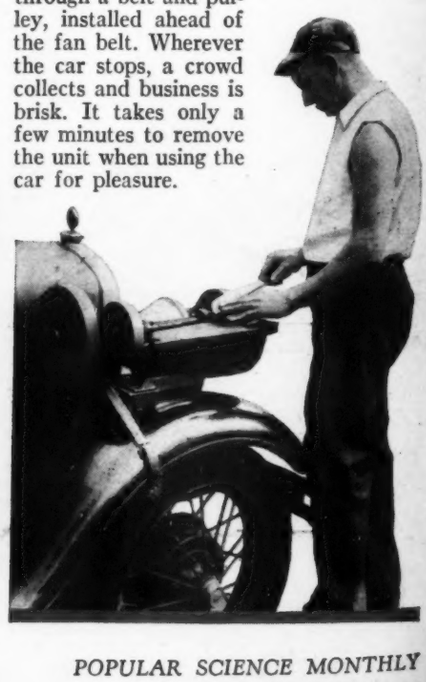
SIX hundred box-shaped death chambers of wire screen are aiding U. S. Department of Agriculture experimenters at Moorestown, N. J., to learn the best way of controlling the Japanese beetle. Each box houses a colony of the insects and exposes them to a poison. Experimental plots of ground are then treated with the insecticides to find whether they are as effective in the field as upon caged beetles. These areas bear signs warning the public, "Treated Plot. Please Keep Off."



In oval, death traps at Moorestown, N. J., in which various poisons are tested in killing Japanese beetles. Above, one of the experimental plots treated with poison in research work

USES AUTO'S ENGINE TO RUN SCISSORS GRINDER

JUNKING his horse-and-wagon outfit, a New York scissors grinder fitted a portable grinding unit of his own design upon the fender of a car. The engine drives it through a belt and pulley, installed ahead of the fan belt. Wherever the car stops, a crowd collects and business is brisk. It takes only a few minutes to remove the unit when using the car for pleasure.



HOLES IN SPECTACLES SHUT OUT GLARE

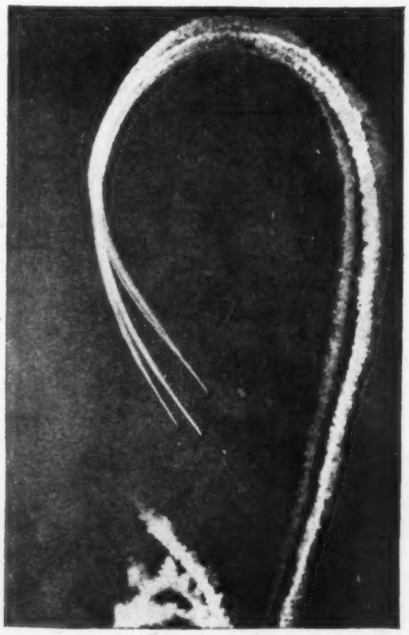
GLARE-PROOF goggles consisting of aluminum cones fitted to the rims of spectacle-like frames have been invented for night driving. The user watches the road through small holes near the apex of the cone. The holes, slightly to the right of the apex, automatically cut out the light beam of an approaching auto. When meeting a car at an intersection, the wearer, tilting his head forward a little, lowers the apex holes, and prevents the light beam from entering the eye. Holes of the same size on the outer sides of the cones give a view of the sides of the road at all times.

Holes near center of these driving glasses shut off light beam and prevent glare; holes at side give lateral vision

Masked Flyers Spray Insect Poison

Pictures show plane spreading insect poison above forest, masked workmen loading poison on plane, and observers in sprayed area

CATERPILLARS ravaging German forests are now attacked from the air with a new kind of poison. This white powder, sprayed from airplanes, settles in a dense cloud and destroys the larvae. So irritating is the powder that workers wear gas masks to protect their throats and lungs while they load the bins of the planes. Pilots are similarly protected. Calm mornings and evenings are chosen for the spraying, since winds arising during the heat of the day might disperse the powder too soon. A director in charge of the operation follows its progress by phone with the aid of masked observers.



THREE PLANES WRITE BIG QUESTION MARK IN SKY

QUESTION marks a mile long were written in smoke recently in the sky near Rome, Italy. Flying in formation, three pursuit planes wheeled above an airfield trailing white clouds of chemical vapor. A fast, merry-go-round circle left a dot in smoke. Then a sweep across the sky formed the rest of the question mark.

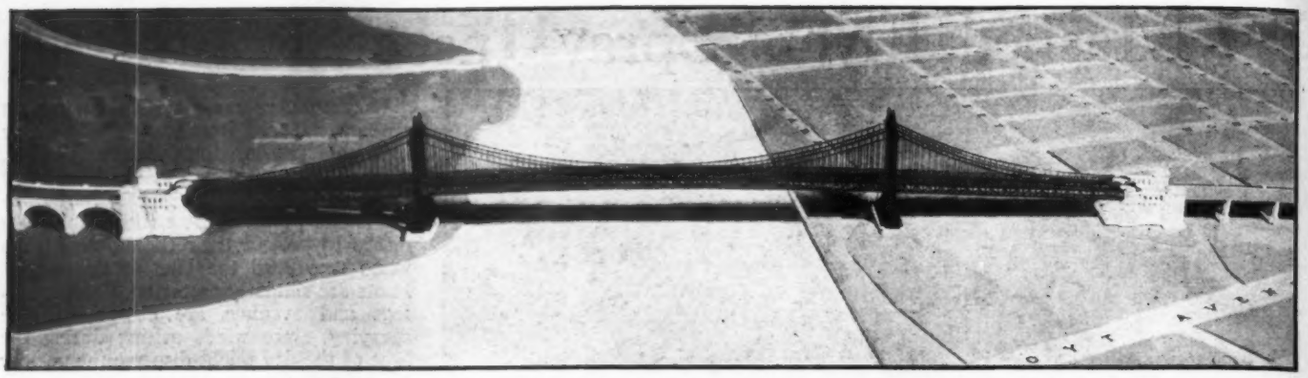
ROBOT ANSWERS PHONE, TAKES MESSAGE

A SECRETARY that never talks back is the invention of S. Young White, New York engineer. His robot will answer your phone and take the caller's message. It will also make a call for you; for example, if you want a long-distance message transmitted at night, you have only to dictate it to the automatic secretary and it will call up the party, deliver the message at any predetermined hour, and record the reply.

The device needs no direct connection with the telephone wires. When the phone bell rings, an "exploring coil" in an attachment mounted just above the bell box is energized by electrical induction. It waits just fourteen seconds, and then operates an arm lifting the telephone receiver from the hook. A phonograph attachment informs the caller that the robot will record the message.

Automatic secretary on the desk answers phone calls, takes message, but does not interfere with regular use of phone

Exploring coil of robot is seen mounted above phone bell box and is operated by induction

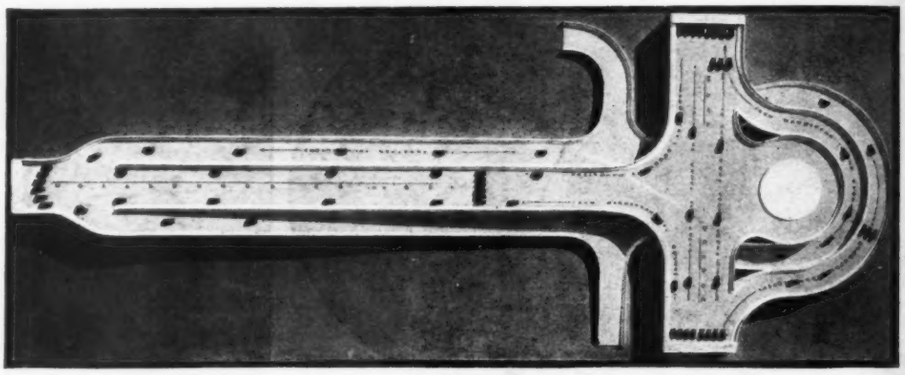


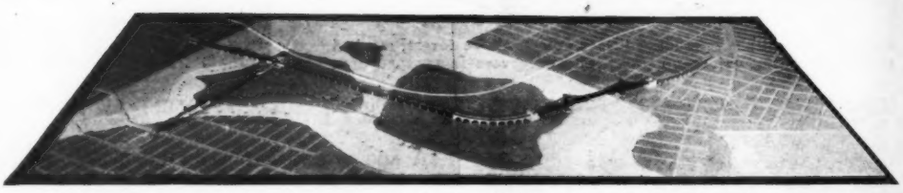
This 1,380-foot span will cross the East River but it will be only a small part of the 17,000-foot bridge planned for New York

New Three-Way Bridge for Cars Will Be 17,000 Feet Long

NEW YORK, city of islands, now plans to solve one of its knottiest traffic problems with a three-way bridge for motor cars. The Y-shaped structure, carrying vehicles between the boroughs of Manhattan, Queens, and the Bronx, will save untold time for motorists who now use ferries or make long detours to existing bridges to cross the natural water gaps separating the boroughs.

By virtue of its magnitude and design, the new Triborough Bridge will be unique among engineering projects. Its three arms will total more than 17,000 feet in length, including a 1,380-foot span across the East River that by itself would rank among the great suspension bridges of the world. All arms join at a level high above the ground of Randall's Island. With three streams of traffic converging at this point, a ramp has been designed to distribute cars in the direction they wish to travel. Engineers estimate the bridge will cost $32,000,000.





Upper view shows the ingenious ramp of three-way bridge that will permit traffic to move in any direction it pleases. Above, air view of a model of the entire Triborough Bridge, seen from Queens

AIR BLOWER DRIVES STRANGE FRENCH BOAT

DEVOID of propellers is a new French craft that runs by "jet propulsion." Its power plant consists of a four-cylinder, sixteen-horsepower gasoline motor driving an air blower. Compressed air from the blower is shot toward the stern, along open slots on the underside of the hull, propelling the craft forward at a speed said to attain nearly forty miles an hour. The flat-bottomed boat draws only nine inches of water.

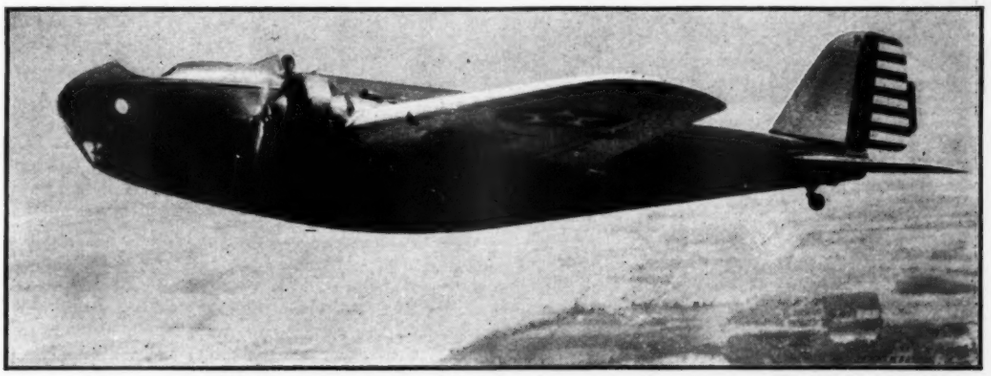
Strange French boat, with nine-inch draft, which is driven by compressed air from a blower

FLIES RAISED TO ORDER FOR INMATES OF ZOO

PAMPERED captives at the National Zoological Gardens, Washington, D. C., enjoy a diet of flies raised especially to their order. Bred in the pyramid-shaped cages of the "fly farm," as shown in the photo, the insects are collected in milk bottles and fed to frogs and lizards.

"Flying Fish," Our Army's Newest Plane, Hits Terrific Speed

STREAMLINING gives the U. S. Army Air Corp's newest plane the appearance of a flying fish. The machine is known officially as a semi-low wing monoplane for light bombardment, and military utility has dominated its design. It is constructed of aluminum alloy throughout. The landing wheels are drawn up in flight, reducing air resistance and approaching the much-sought aeronautical ideal of a flying wing. Two powerful engines mounted on the wing propel the machine at terrific speed.



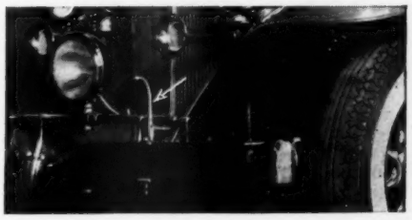
Highly streamlined, this newest of the U. S. Army planes gives the appearance of a flying fish when in the air. It is powered with two engines and in tests has attained unusually high speed

RAILROAD WORKERS BUILD MODEL OF CRACK TRAIN

WORKING during their spare time, employees of the Santa Fe railroad at Topeka, Kan., have built a remarkable model of one of the line's crack trains. The locomotive is about five feet tall and runs under the power of an old four-cylinder automobile motor. Actual smoke from burning oil comes from the smokestack to give the illusion of reality. Each coach is made of steel and electrically lighted.

The "train" runs upon rubber-tired wheels. In the dining car are tables with linen laid and each chair occupied by a doll diner. There is an observation car with brass railing at the rear and folding chairs on the platform. All seats are upholstered in plush, and leather covers drawing room chairs.

This model of a crack Kansas train, complete in all details, was built by railroad employees in their spare time

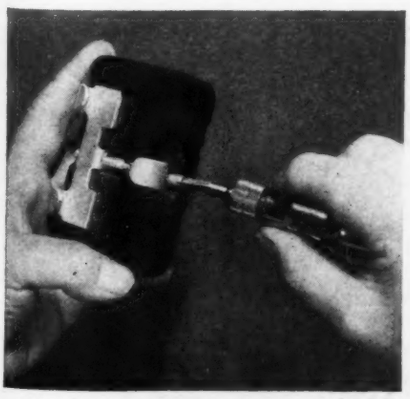


PARKED CAR GUARDED BY ELECTRIC "FEELER"

AN INGENIOUS "electric feeler" guards a parked car while its owner is away, sounding the horn if a careless driver is backing into it. This curved metal arm with an electric switch at its base is mounted on the car's bumper about eighteen inches from the left end. A light touch on the arm is sufficient to close the switch and sound an alarm on the car's horn.

NON-SKID PADS CLAMP TO CAR'S PEDALS

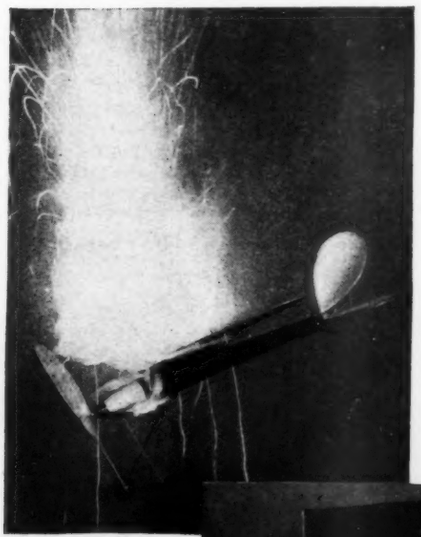
EASILY and firmly attached to your car are rubber pedal pads that keep your feet from slipping off the clutch and brake controls. Sliding metal hooks on the back of each pad grasp the pedal securely when brought together by turning a connecting screw, much in the manner of attaching skates with a key, as demonstrated in the photograph below. The rubber surface of the pad is corrugated in a non-skid design.



Rubber non-skid pad that can be fastened to brake and clutch pedal by mere turn of screw

NEW AIRPLANE DOPE DEFIES BLOWTORCH IN TEST

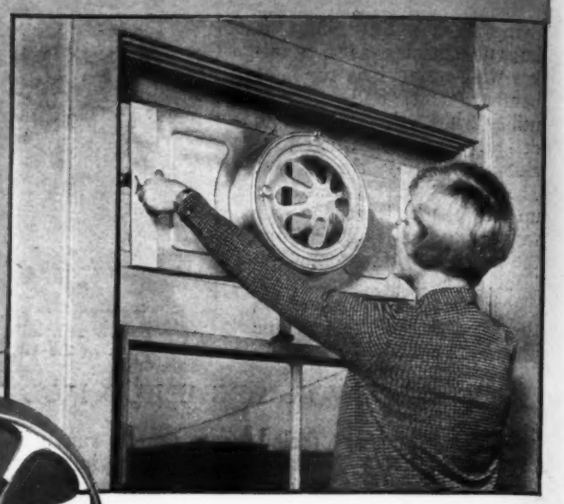
DEVELOPED especially for airplane use, a new fireproof dope has been adopted by German airplanes, following successful laboratory tests. In one of the experiments, a wooden slab was coated with the compound and exposed for twelve minutes without damage to the heat of a blowtorch. A model airplane was used in another test, the wings and fuselage being treated. Bathed in the shower of flame and sparks seen in one of the photographs, they emerged unharmed.



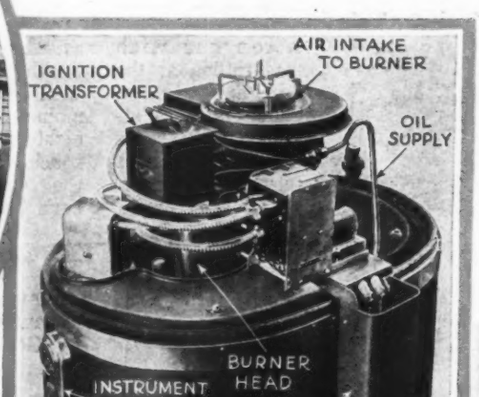
Above, model airplane treated with new fireproof dope developed in Germany was uninjured by shower of flame. At right, slab of treated wood does not burn when in the flame of a blowtorch

HOUSEKEEPING

SELF-FOLDING CORD. This electric iron has a silk cord arranged in a series of flexible loops so that it is never in the way. An elastic winding, which is hidden away beneath the insulation, exerts a pull on the cord that keeps it constantly folded

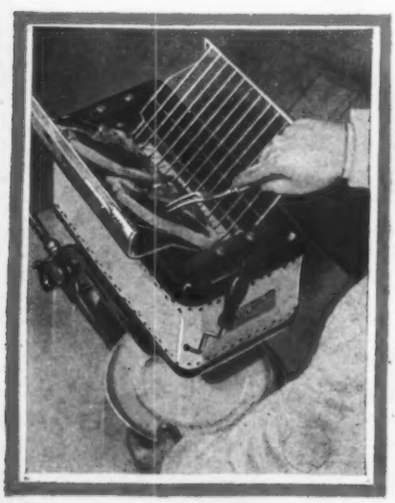


DOUBLE-DUTY FAN. An electrical fan panel, as shown above, is designed for kitchen window and will ventilate and cool the room. The fan unit, however, is removable and may be used as an ordinary fan in any part of the house by merely placing it on a table and plugging in as shown in the picture at left



AUTOMATIC OIL FURNACE
Boiler and hot water heater are combined in the furnace two views of which are shown above. At left is seen the exterior of the heating unit and at right, top of boiler with cover removed

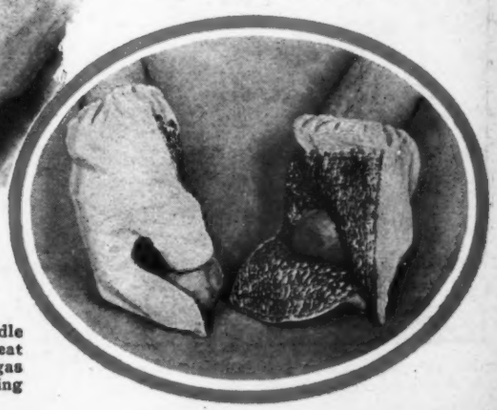
VERSATILE HANDLE. Long enough to reach the bottom of the tallest glass, this handle not only stirs but can be used to pull corks, open bottles, remove caps, and squeeze lemons or oranges



RUBBER HAND BRUSH. When used with soap and water, this brush, of rubber, does not injure the hands and cleans them thoroughly

BROILER TURNS ON GAS. When the handle of the broiler, left, is pushed down it puts the meat into cooking position and also turns on the gas and regulates the heat while the food is cooking

GLOVES PEEL POTATOES. Canvas gloves, below, have palms covered with thin strips of twisted and stretched copper. When a potato is grasped and rubbed with a rolling motion between them the peel is removed. A bit of metal on one glove digs out eyes



TOOLS *to Minimize Labor*

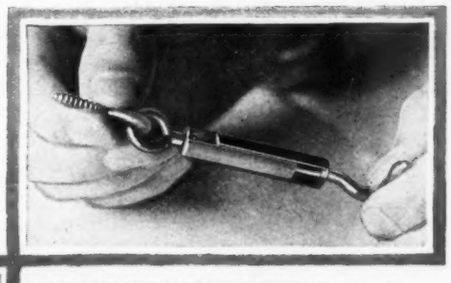
ROAST CAN'T SLIP. Holding devices on this meat tray prevent roast from slipping while being carried or carved. A spring, in each grip, holds meat so carving can be done with one hand

BRISTLES AND RUBBER. Into this sponge rubber brush, bristles have been set so that it is really a combination bath brush and sponge. Bristles are so attached that they do not easily fall out

WATER AND AIR FAN. Your room is cooled and moisture added to air with this electric fan. The fan is behind a reservoir of water agitated by a rubber belt so fan sends out a fine spray

GLASS JAR TOPS REMOVED. Heavy ridges inside this rubber ring are designed to grasp top of a glass jar of any size and hold it so firmly it can easily be twisted loose

NO DUST IN CORNERS. Four-sided blocks, shaped to fit in stair corners, can be put in place and held with a drop of glue. They keep dust from gathering in the corners and make it easy to clean stairs. Once in place, they can be stained to match woodwork and add to appearance of stairs



AUTOMATIC DOOR HOOK. Screen doors are held shut with a hook that expands or contracts to allow for swelling or shrinking

YOU CAN'T LOSE THIS CAP. Quickly attached to tubes of dental or cold cream, this rubber cap is held to the tube by its rubber ring, and thus cannot be mislaid

LID AND KETTLE. A series of different-sized rims, in the bottom of this kettle, make it possible to use it on almost any saucepan. When placed on saucepan, it becomes a cover and at the same time water can be boiled in it by heat of cooking food

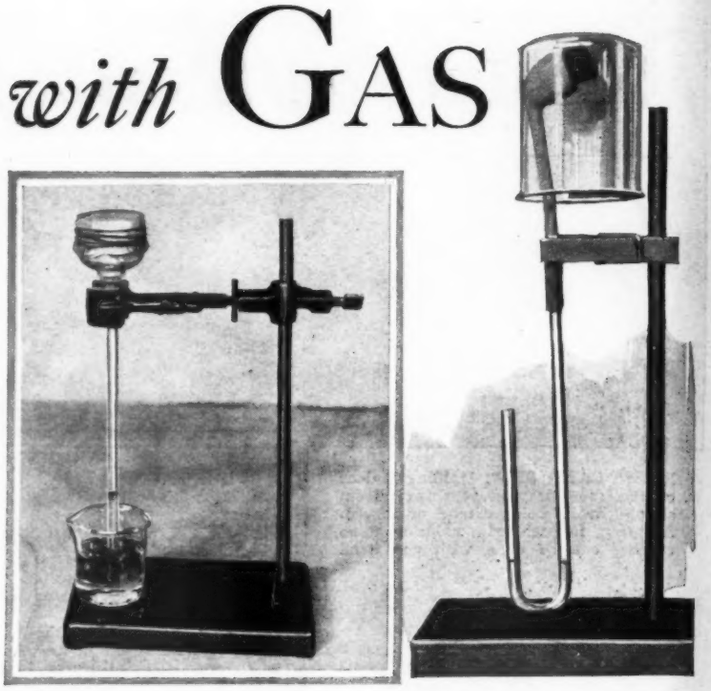
COMB CLEANER

With brushes for jaws and spring tongs that are tightly fitting, this new comb cleaner has no trouble in removing hair and dust from the comb. It is itself readily cleaned for further use by washing in running water with soap

HOLDS COLLAR BUTTONS. Ties are kept handy and in order on this novelty rack and in addition it carries, in a groove, the buttons for a man's shirt so they are never lost and cannot escape to hide under the bureau

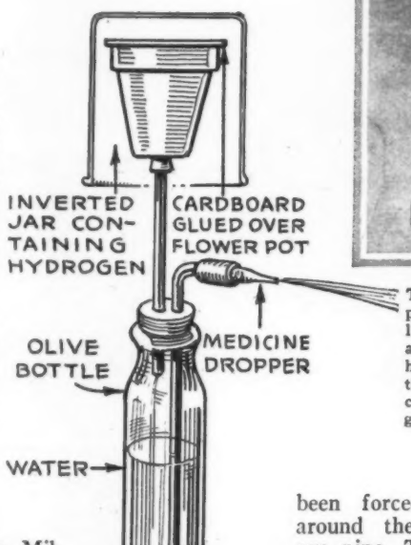
Experiments with GAS

Simple Apparatus, Easily Arranged, That Can Be Used to Demonstrate Industrially Valuable Properties of Gases, Solids, and Common Solutions



THREE EXPERIMENTS IN DIFFUSION OF GAS. At left, flowerpot, filled with hydrogen and sealed with air-tight cardboard and, upper left, inverted funnel containing hydrogen and closed with rubber while, at upper right, a closed bubble pipe in an inverted tumbler into which hydrogen is permitted to flow. In the first two cases the gas passes through the cardboard and rubber faster than air can escape and thus creates a vacuum that causes the water to rise. In the pipe test, the gas, entering the bowl, increases the pressure and moves water in U tube

DO YOU remember when, as a boy, you left your gas balloon pressing against the ceiling when you went to bed and the next day found it on the floor, full of wrinkles and half deflated? And how you blamed the balloonman for not having tied the thread tightly? The truth is that no matter how tightly the thread was tied, the hydrogen would leak out through the rubber itself. Such a flow or escape of a gas is called diffusion.



All around you, in hundreds of ways, this process of diffusion is going on. Millions of motorists, for example, wonder why their tires go down and have to be pumped every so often, when there are no leaks in the tubes. Diffusion is the answer. Molecules of air are constantly finding their way through the maze of invisible pores in the rubber to join their relatives in the outside atmosphere.

Here is a way to demonstrate in a dramatic manner the effect of diffusion. Set up a hydrogen generator consisting of a test tube containing a lye solution into which some pieces of scrap aluminum have been dropped. Now take a small funnel made from the top of a bottle and over the large opening, fit tightly a piece of thin balloon rubber, using rubber bands to hold it in place. Now hold the funnel rubber side up and push the delivery pipe from the hydrogen generator up into the funnel. Allow the gas to flow into the funnel until the air has been forced down and out around the generator delivery pipe. Then quickly fit a cork, containing a piece of glass tubing, to the neck of the funnel and set up as shown above, with the end of the tube immersed in a beaker of water. In a few seconds the water will begin to rise into the stem of the funnel.

This action is explained by the kinetic theory of gases which assumes that all molecules of gases are in motion. The molecules of hydrogen gas inside the funnel, being lighter and smaller, move out through the rubber faster than the heavier and larger air molecules can get in through the rubber, so a vacuum is formed within and water rises up the stem to equalize the pressure. Illuminating gas, which contains hydrogen, can be used instead of pure hydrogen gas.

A clay bubble pipe is porous and if the stem of the pipe is fitted with a glass U tube by means of a rubber tube, and mounted as shown at upper right, a still more interesting experiment in diffusion can be performed. The bowl of the pipe must be closed by means of a tight-fitting stopper. Invert a tumbler over the bowl of the pipe and hold the end of a tube from which hydrogen or illuminating gas is issuing in the inverted tumbler. The gas will soon drive out the air. It will also go into the pipe by way of the invisible tiny holes in the clay.

MOLECULES of air within the bowl of the pipe are also coming out through the holes, but the hydrogen molecules get through so much faster that more hydrogen goes in than air comes out. This, of course, increases the pressure within the pipe and the water in the U tube is pushed over into the other arm. You may omit the U tube, if you prefer, and thrust the stem of the bubble pipe directly into water and note the bubbles coming from the end of the stem.

If a miniature flowerpot is used instead of the bubble pipe, the surface available for the diffusion process is greatly increased. Enough pressure will be produced to force a stream of water through a medicine dropper. The flowerpot should be closed by cardboard, using wax. A stopper carrying a tube is fitted into the hole in the bottom and passes into an olive bottle as shown in diagram above. The apparatus should be tested for leaks by blowing into the medicine dropper. The experiment will fail if leaks are present.

Liquids also diffuse, though more slowly than gas, and the speed varies with different solutions, as some simple experiments show. Fill two test tubes with water and into one drop some crystals of

Do You Know Your CHEMISTRY?

Before you read this article, see if you can answer correctly the following questions. The answers are given in the text on this and the next page.

1 **How does air get out of a perfectly good auto tire?**

2 **What is this process called?**

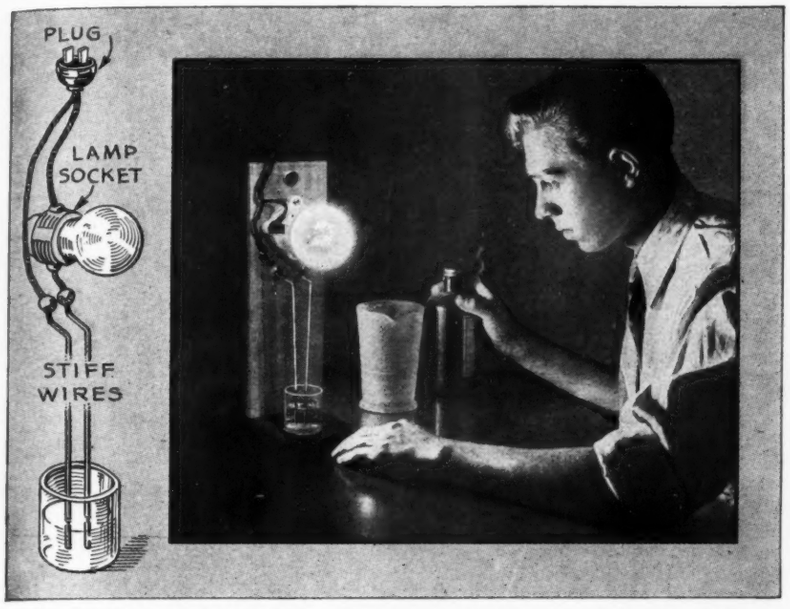
3 **Will anything besides gas act in the same way?**

4 **What is meant by saturation and supersaturation?**

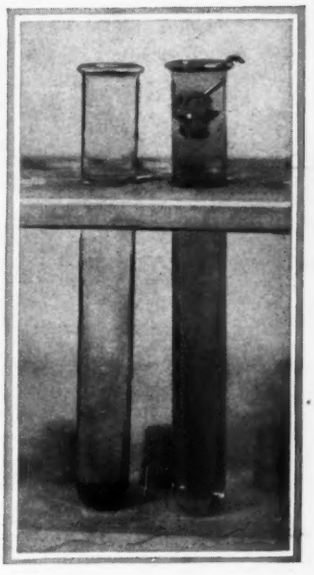
5 **Why does some dyed cloth change color on rainy days?**

for the Home Laboratory

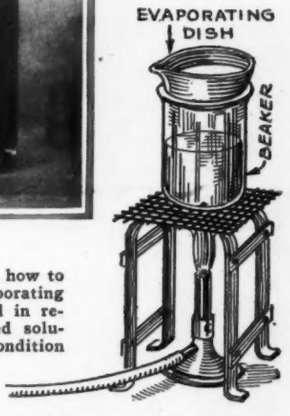
By Raymond B. Wailes



TO TEST AN ELECTROLYTE. With this apparatus it is easy to determine whether a chemical solution is a conductor of electricity. When acids, alkalies, or salts are dissolved in water, the resulting solution is an electrolyte, or conductor of electricity. If the electric lamp glows when the wires are inserted in a liquid, it is electrolytic



DISSOLVING CRYSTALS. If, into a test tube filled with water, crystals of chemicals are dropped, they diffuse very slowly through the water, often requiring months. If, however, the crystals are placed at the top of the liquid, solution will be effected in one or two minutes



Drawing shows how to arrange an evaporating dish to be used in reducing saturated solution to syrupy condition

copper sulphate or nickel ammonium sulphate to produce a highly colored solution. In the second tube suspend the same kind of chemical in crystal form in a little copper wire basket so that it is at the top of the tube. The crystal in this second tube will dissolve and the solution formed will settle throughout the water in the test tube in perhaps a minute or two. If undisturbed, it may take several months for the solution in the first tube to become uniformly colored. At first the dense solution will stay at the bottom of the tube, but the colored solution will eventually diffuse throughout the entire test tube by the same process of molecular action that caused the novel effects with gas. Advantage can be taken of this experiment in dissolving quantities of crystals in water. Solution will be effected very quickly if the crystals are contained in a bag or suitable perforated metal or glass receptacle at the top of the water.

JUST as some chemicals go into solution slowly if conditions are not favorable, it has been found that some chemicals come out of solution very rapidly.

If chemical solutions of salt, copper sulphate, sugar, or potassium nitrate are allowed to evaporate slowly, the substances dissolved will gather in large crystals. If the solutions are heated to hasten evaporation, small crystals are formed. In either case, when the solution is just about ready to crystallize, the solution is said to be *saturated*. If more of the crystals can be dissolved in a saturated solution without causing crystallization, the solution is said to be supersaturated, and then a slight jar or jolt will cause the whole solution to crystallize almost instantly.

In making carbon dioxide gas using marble chips and muriatic, or hydrochloric acid, the solution which results is calcium chloride. To make calcium chloride show the properties of supersaturation, heat it gently until a piece of marble in it no longer gives off carbon dioxide gas. Then remove the marble chip. Continue heating until a thick syrup is formed. Allow to cool to room temperature without disturbing the liquid. If the vessel is now gently twirled after cooling, the thick solution will immediately change to a solid mass of calcium chloride crystals. The crystals will become exceedingly warm when this happens.

Practical use is made of this fact in some of the chemical heat bottles and bags. Crystals of photographer's hypo, sodium sulphate, sodium acetate, or ferric nitrate when heated *without water* in a flask or beaker become liquid, and finally syrupy. In this condition they can be made to crystallize out immediately by shaking or by adding a small crystal of the substance. In some cases the crystallization is slow, but fast enough to watch the crystals grow. Sometimes the growth is an inch a minute.

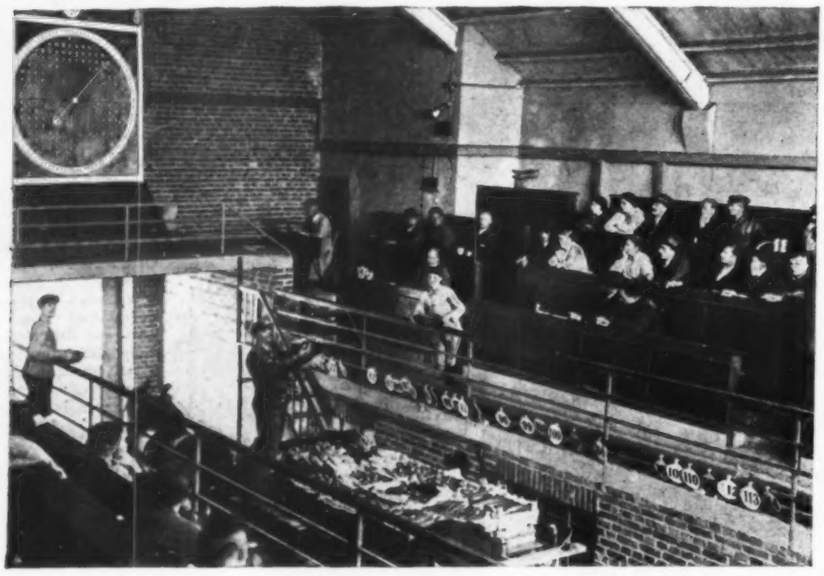
WHEN crystals are dissolved in water, the solution will exhibit a variety of properties. If the crystals or solid is an acid, an alkali, or a salt, which is the product formed by the reaction between an acid and an alkali, or base, then the solution formed in water always is a conductor of electricity, and is said to be *ionized*. A simple apparatus to distinguish electrolytes from nonelectrolytes can be made from a lamp, mounted on a board and connected to the house lighting system. Drawing and photograph above show the arrangement. The lamp will light when any conductor is placed across the two stiff copper wires, which are mounted on the board and which can be dipped into a small vessel of solution to be examined.

Dipping the ends of the wires into solutions of copper sulphate, salt, potassium nitrate, acids, alkalies and similar chemicals will cause the lamp to light. Some solutions will cause only a faint glow. Use the same amount of substances and water when experimenting. Interesting tests can be made on alcohol, sugar solution, distilled water, vinegar, soft drinks, and also on dry salt or sugar.

AN IMPORTANT property of solutions is their strong tendency to remain in the liquid state. It is for this reason that solutions have higher boiling points and lower freezing points than the solvents from which they were made. Honey—a simple solution of sugar and other substances in water—for instance, may be exposed to the air almost indefinitely without evaporating, while water under the same conditions will soon disappear completely. Similarly, sea water, another solution, remains unfrozen while fresh water cooled to the same extent will become covered with ice. It is this property of solutions to remain in the liquid state that makes it possible for us to melt ice by sprinkling it with salt and to test milk for the addition of water by carefully determining its freezing point.

The parts of a mixture can often be separated by taking advantage of their difference in *(Continued on page 86)*

ELECTRIC CLOCK SPEEDS FARM AUCTION



ELECTRIC "clocks" are now used in Germany to speed up farm auctions. Wagonloads of produce are displayed. Then the buyers take their places in stalls, and the auction begins. As each load is put up for sale, the hand of the clock starts moving from 100 downward, indicating the sale price. When the price is satisfactory to any buyer he pushes an electric button that stops the clock's hand. If the hand reaches too low a figure, the owner may push a button flashing the words "no sale."

FISH LIVES IN SEALED GLOBE

SEALED in an air-tight globe, a goldfish recently lived for three months at the North Dakota Agricultural College, at Fargo. Within the globe, water plants were fed by the carbon dioxide given off by the fish and produced oxygen, while the fish ate the plants.

USE STEAM SHOVEL TO UPROOT TREES

DURING the building of a road near a Chesapeake Bay summer resort, the problem arose of removing a number of fair-sized trees. Ordinary methods of cutting them down and removing the stumps would have delayed the work, so the contractor used a powerful steam shovel. With this he uprooted the trees bodily, to the delight of numerous spectators. Moreover, the holes left by the improvised tree-puller were said to be smaller and to require less filling-in than ordinarily would have been the case.

Steam shovel uproots trees and swings them out of road builder's way

Cash Prize WINNERS *in our July Heroes of Science Contest*

Here Are the Names of Twenty-Nine Whose Skill and Application Brought Them Cash Rewards in Our Big Picture Cutting Contest in July Issue

FIRST PRIZE $500

Earl Sargent,
Atlanta, Georgia

SECOND PRIZE $100

Elwin C. Leslie,
Lakewood, Ohio

THIRD PRIZE $50

Hester K. Sanford,
Floral Park, N. Y.

SIX $25 PRIZES

Jean Allen, *Washington, D. C.*
M. Chase Cooke, *Los Angeles, Calif.*
Charles Held, *West Toledo, Ohio*
Marye C. Hicks, *Chicago, Ill.*
C. E. Madden, *Fort Worth, Texas*
Charles W. North, *Glenbrook, Conn.*

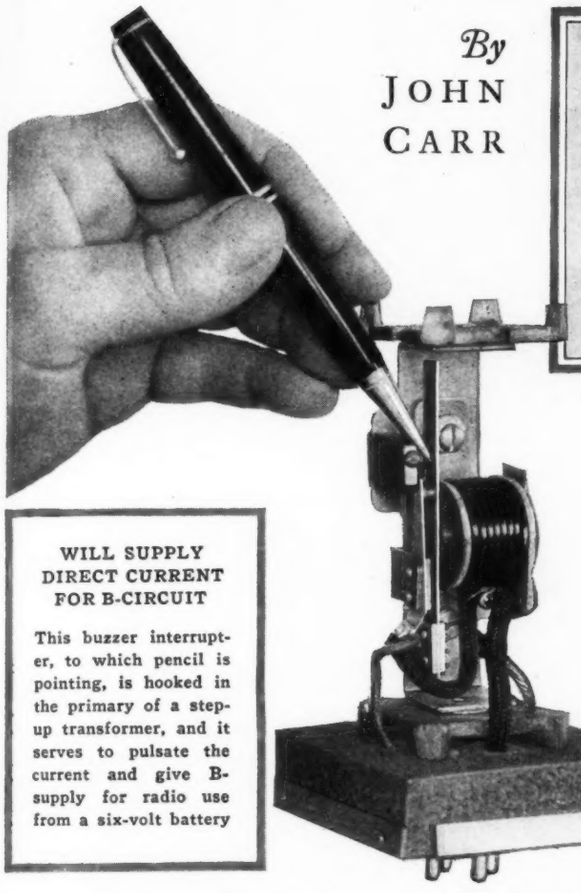
TWENTY $10 PRIZES

Elmer B. Benson, *Moline, Ill.*
W. M. Boyle, *Bakerstown, Pa.*
I. Caclaudie, *Asbury Park, N. J.*
H. Castleberry, *Legion, Texas*
A. F. Conron, *New York City*
Albert E. Cooper, *Philadelphia, Pa.*
Henry Dammeyer, *Indianapolis, Ind.*
John H. Richardson, *Ridgewood, N. Y.*
Jay A. Davis, *St. Helena, Calif.*
Lela Engle, *South Bend, Ind.*
David Felzer, *Waukegan, Ill.*
R. Geller, *Pittsfield, Mass.*
C. W. Glenn, *Jackson, Michigan*
Charles Gray, *Brooklyn, N. Y.*
John L. Moore, *Ortega, Fla.*
Bryan Hadley, *Clayton, Ind.*
A. G. Kalmbach, *Grand Rapids, Mich.*
Charles H. Kuhn, *Indianapolis, Ind.*
Ethel Millspaugh, *Anderson, Ind.*
John Perry, *Glen Lock, Pa.*

THESE NOVEL SYSTEMS WILL SUPPLY

B-current *for Your Radio*

By JOHN CARR



WILL SUPPLY DIRECT CURRENT FOR B-CIRCUIT

This buzzer interrupter, to which pencil is pointing, is hooked in the primary of a step-up transformer, and it serves to pulsate the current and give B-supply for radio use from a six-volt battery

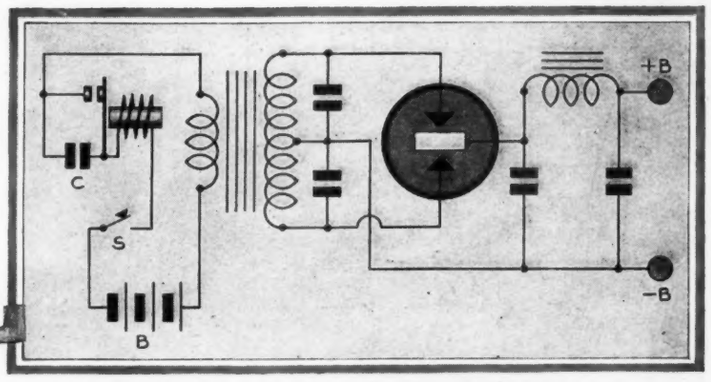


Fig. 1. Diagram shows the circuit of the buzzer interrupter type of B-eliminator supply unit which you can build at a very trifling expense

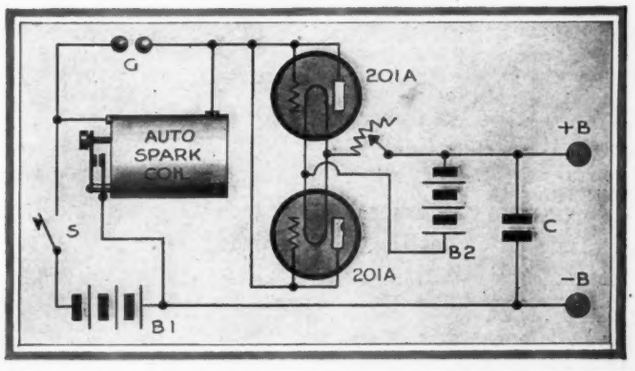


Fig. 2. Diagram showing how an auto spark coil is used to get high voltage B-current for radio receiver or transmitter

IN SECTIONS remote from electric power lines, the radio experimenter is confronted with the question of how to get an adequate supply of high voltage, filtered direct current for B-circuit use.

The most obvious solution is heavy duty, dry cell B-batteries, but there are other ways to get high voltage direct current that can be filtered or smoothed out for radio B-service on receiver or transmitter.

There is, for example, the small dynamotor set that draws six-volt current from a storage battery and generates a supply of current at 180 volts (P.S.M., July '32, p. 63). This unit, including the necessary filter circuit, is complete in one small case. For automobile use, where the storage battery is kept charged by the car's generator, the dynamotor is excellent. Also, it can be used on farms equipped with thirty-two-volt lighting systems.

Another new form of B-supply, designed to run on a six-volt storage battery, employs a buzzer circuit breaker in connection with a step-up transformer and a rectifier tube. It will prove practical in any service where the dynamotor unit can be used to advantage. The buzzer circuit breaker is shown in photograph above, removed from its sponge rubber lined case. The heavy sponge rubber lining is needed to muffle the mechanical sound of the vibrator.

The vibrator interrupter or buzzer breaker type of B-supply circuit is shown in theoretical form in Fig. 1. It works because an interrupted or pulsating direct current has about the same effect on an alternating current transformer as does real alternating current, provided the rate of pulsation roughly corresponds to the frequency for which the transformer is designed.

The rate of make and break can be regulated by the length and stiffness of the steel spring armature. Condenser C is important because, without it, the breaker points would soon burn away. It should have a value from one-half to one microfarad. The set-up transformer must be specially wound, as the power transformers usually available have a primary adapted to one-hundred-and-ten-volt supply, and would not be usable on six-volt current unless rewound.

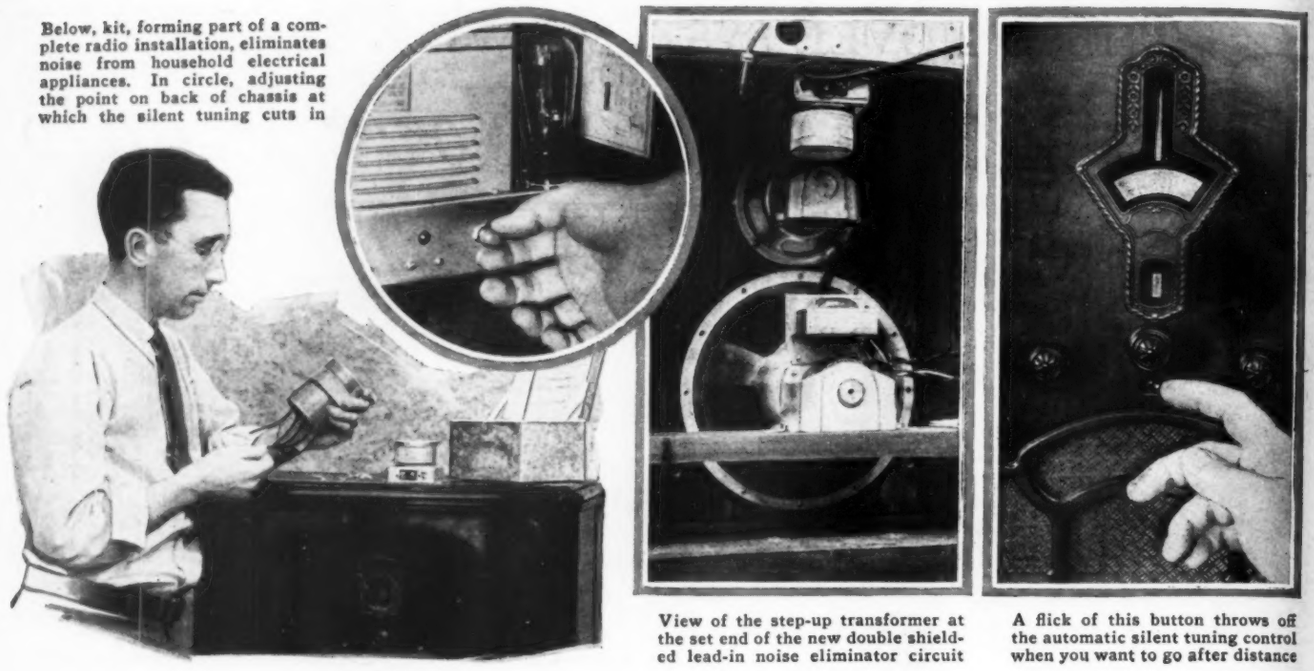
Another way to obtain high voltage B-current from a low voltage direct current source is shown theoretically in Fig. 2. An automobile ignition coil of the vibrator type is operated by battery B-1. A couple of 201A tubes, connected with their grids and plates in parallel, serve to rectify the high tension current. The filaments of the tubes must be supplied from a separate battery, B-2, because everything connected with the tubes is at high voltage with respect to the other battery, B-1, and the minus B side of the line.

The B-supply systems of both Figs. 1 and 2 should be particularly interesting to amateur radio operators who live where no electric light current is available.

Either system can be used with a low-power radio transmitter. The interrupter operated B-supply of Fig. 1 is technically more desirable because it will give a more satisfactory output and is more economical of current. The chief difficulty with the spark coil supply of Fig. 2 is that a spark coil is not well adapted to this work. The secondary is wound with many turns of fine wire and the secondary output develops several thousand volts more than you need. This excess voltage is wasted. Spark gap G should be set so close that any sudden voltage surge will cause current to flow across the gap and thus save the tubes from overloading.

A gaseous type rectifier tube is shown in Fig. 1. It is possible to use such a tube in place of the two 201A tubes in Fig. 2 and thus save the use of the extra battery.

For a small portable transmitter, the spark coil can be operated with flashlight cells and the current rectified with a gaseous tube. This will reduce both the cost and weight *(Continued on page 98)*



Below, kit, forming part of a complete radio installation, eliminates noise from household electrical appliances. In circle, adjusting the point on back of chassis at which the silent tuning cuts in

View of the step-up transformer at the set end of the new double shielded lead-in noise eliminator circuit

A flick of this button throws off the automatic silent tuning control when you want to go after distance

New RADIO SETS Tune

IF YOU have never turned the tuning knob on one of this season's radio receivers, you have a new sensation coming to you!

Last month I discussed the various circuit improvements of the latest sets. They are important, because they insure better radio performance, but they seem almost insignificant when compared with the strides made in radio control. In this respect, radio has closely paralleled the development of the automobile. Where formerly we had to crank the engine and learn all sorts of tricks in order to change gears quietly, we now have automatic starting, silent shifting, free-wheeling, and other features that take all the hard work out of auto driving.

Now, in radio, we have automatic volume control, automatic tone control, visual tuning, manual silent tuning, automatic silent tuning, noise elimination, and other features to make the radio receiver so easy to handle that even a baby can tune the set and tune it right.

If you have a radio set that is more than two years old, you know that when you tune through the broadcast range, one station may come in with a roar that nearly splits your eardrums and the next may be nothing but a faint whisper, while in between the stations, there will be the steady snapping and snarling of static.

With any old-time set, this result is inevitable. The intensity of the signal from different broadcasting stations, even semi-local ones, may vary as much as one to a hundred thousand or more at your antenna. No matter how you set the ordinary hand volume control, you can never hope to get more than one or two stations at the right volume without readjusting.

Automatic volume control, on which many of the other new features depend, has been experimented with for several years. Last year it became an accepted feature, although it was not fitted to all sets nor did it function any too well on some of the sets that had it. There are various methods of obtaining automatic volume control. All work on the principle of using the strength of the incoming carrier wave to vary the sensitiveness of the radio or intermediate frequency amplifier stages of the receiver. The stronger the incoming carrier wave, the less the receiver amplifies, and the weaker the incoming wave, the stronger the amplification.

In theory, this system should bring in all stations within the local and semi-local range of the set at precisely the same volume. It is not quite that nearly perfect, however, because there are differences in the degree of carrier modulation—that is, in the ratio of carrier wave to sound vibration strength. This variation is rapidly becoming less and less as the weaker stations improve their equipment. In any case it is not likely to be greater than one to four, comparing the best equipped station with the worst heard in any given locality. A change of volume in the ratio of one to four seems trifling to the human ear and amounts to nothing as compared with the tremendous variation found in sets without automatic volume control.

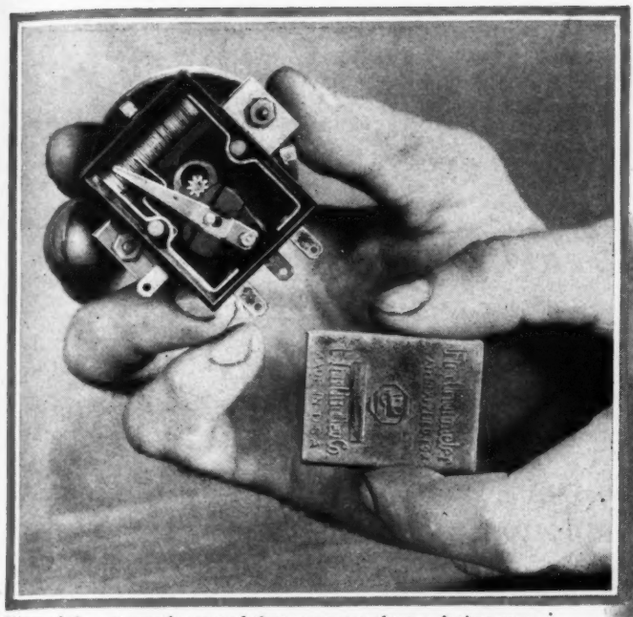
WITH such an arrangement, it is obvious that the set is operating at maximum sensitiveness when no signal is being received. This would result in a deafening roar of static at points in between stations. In early models incorporating automatic volume control, a button was provided to cut out the loudspeaker while tuning. Now we have automatic silent tuning. You hear nothing at all between stations. The sensation of tuning a modern set seems almost weird to the old-time fan accustomed to roaring static and any old volume level.

The method by which the static between stations is choked off is extremely ingenious. The carrier wave is utilized to operate either a mechanical relay or an electrical equivalent of it, which cuts out the speaker or "kills" the automatic amplifier end of the set when the carrier wave strength falls below a certain minimum. This minimum can be adjusted, usually by a separate small knob at the back of the set, so that any station that can be heard through the normal static level will cut in or "turn on" the amplifier or speaker.

THIS combination of automatic volume control with automatic silent tuning (sometimes slightly different terms are used to designate these functions) is ideal for the average radio user who wants maximum entertainment with minimum trouble.

It does not, however, suit the ardent radio fan who likes, now and then, to go hunting for distant stations. It would be inconvenient if you had to adjust the silent tuning control on the back of the set each time you wanted maximum sensitivity for distance fishing, so a simple throw switch on the front panel, or some equivalent set-up, is supplied. This permits cutting in or out the silent tuning by a flick of the finger. Minus the silent tuning, but with the automatic volume control still on the job, the set becomes ideal for going after the faraway weak stations. You get no thunderous roar when you happen to pass through the setting for a powerful local station.

In some of the simpler sets, manual silent tuning is employed instead of the more elaborate automatic variety. In these less expensive models, a button must be



View of the automatic control that governs volume. A tiny gear on the end of the control shaft moves the special resistance contact arm to change the set's tone quality to fit the human ear

Knob Twisting to Get Right Volume and Tone Is Unnecessary with This Year's Noise-Eliminating Receivers

By ALFRED P. LANE

Left, turning this knob on one of the latest sets does double duty, as it changes the volume and tone

Themselves

pressed while you are tuning to get the silent effect between stations.

Visual tuning, which substitutes an accurate setting by eye for the uncertain and usually inaccurate tuning by ear, is now a feature of about seventy percent of the new receivers. Several makes of sets use the climbing neon light which shows by the height of the red glow when the set is precisely in tune. Others use various forms of meters, the position of the indicator giving the same information.

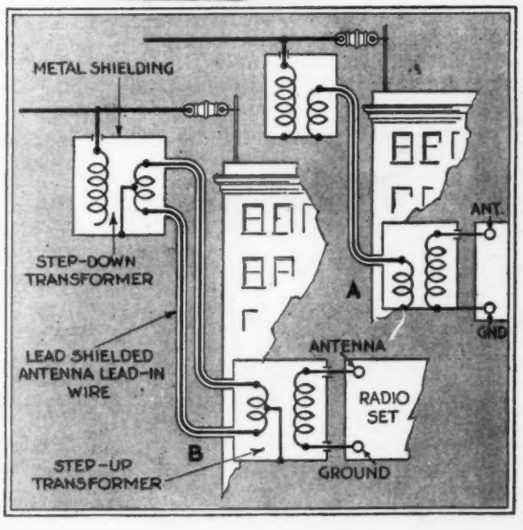
Automatic tone control, also called tone compensation and other names, is incorporated in some of the latest receivers.

It has been known for some time that tone reproduction approaching theoretical perfection does not sound exactly right to the human ear unless the volume from the speaker equals the volume actually produced in the broadcasting studio. At anything less than studio volume, the effect on the ear is as though a soft pedal had been applied both to the higher frequencies that make speech understandable, and to the lower frequencies that form the bass.

There are few occasions when the radio user wants studio volume in the home, and as a result the best old-time sets were, in effect, giving distorted reproduction most of the time.

AUTOMATIC tone control compensates for deficiencies in the human ear. When you turn down the volume on a set having this feature, the relative strength of both the top and the bottom of the tone scale are increased with respect to the middle register. The volume control knob on the front of the receiver therefore turns, in addition to the volume level potentiometer, a switching or resistance arrangement that produces the desired change in tone characteristics.

The elimination of unwanted noise in radio reception always has been the goal of radio engineers. So far, no way has been found to get rid of natural static except to increase the strength of the broadcasting. This has been done to the point where local and semi-local stations give satisfactorily noise-free results from your speaker. This is unfortunately not true with regard to man-made static, the noise forced out of your speaker by a thousand and one types of small household electrical appliances.



Below, diagram of new antenna systems to eliminate noise caused by electrical apparatus

IT HAS been known for several years that a high, and relatively long, outdoor antenna brings in more broadcasting, with relation to the man-made static picked up by the lead-in and the set itself, than does a short indoor or loop antenna. That is why the loop has disappeared and the indoor antenna is used only when unavoidable. Carefully shielding the set and using a shielded lead-in helps, but the shielded lead-in defeats its purpose by cutting down the strength of the radio impulses.

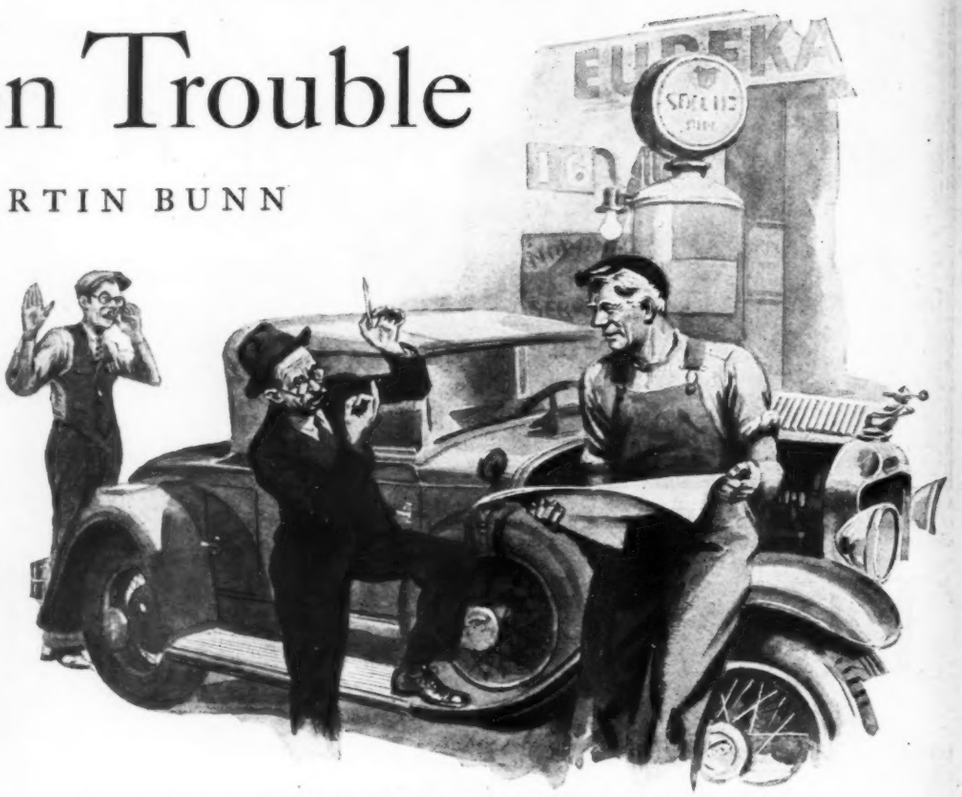
A way around this trouble has been found and we now have systems that cut out nearly all the man-made static. The diagram shows variations of the latest thing in noise elimination. In operation, a high-frequency, step-down transformer attached to the antenna feeds the radio signals down the shielded wire at much lower voltage. At the set, they are stepped up to the original voltage by another high frequency transformer. The secret lies in the fact that the losses due to capacity in a shielded lead-in are far less at lower voltage.

The double shielded lead-in system has the advantage of center-tapped low voltage windings. This halves the effective voltage with respect to the shielding. A system like this is sold only as part of a complete radio installation.

AS A result of all these changes and improvements, the sets this fall are more selective than ever, with a more faithful reproduction of tone quality. However, their most distinctive feature, probably, is the ease with which they are manipulated—a characteristic that will make a strong appeal to the vast majority of radio broadcast listeners.

How Car's Ammeter Can Warn of Ignition Trouble

By MARTIN BUNN



"It's a new kind of automobile that doesn't use gasoline. It would bring you in at least a million," Dilbow explained. "Sounds important," Gus said. "Tell me about it."

"WANT to make a million dollars?"

Gus Wilson, veteran auto mechanic and half owner of the Model Garage, pulled his head from under the hood of the car on which he was working.

"Hello, Pete," he said. "What's the big idea now?"

Pete Dilbow glanced furtively about over the tops of his spectacles. "You're going to be out of a job soon!" he announced impressively. "All these cars are obsolete. They'll go straight to the junk pile soon as I get some of the little details of my latest invention worked out. It's a new kind of automobile that doesn't use gasoline. I thought, since you're in this business, maybe you'd go in with me for about a tenth share. That would bring you at least a million and maybe ten times that much, if we're lucky."

Gus had been offered shares in Pete's inventions many times, but nothing had ever come of any of them.

"Sounds important, Pete," Gus told him. "Tell me about it."

At that Dilbow drew out a neatly folded sheet of brown paper and spread it out in front of Gus.

"Here," he explained, "is the design of a new kind of automobile. Learning how an ordinary car works, I had a wonderful idea. Instead of using a little motor to start the engine, I put in a motor big enough to run the car, then I put in a big generator or dynamo and a large size storage battery. The current from the battery runs the car and the dynamo keeps the battery charged. What could be simpler than that?"

"Sure is one grand idea, Pete," Gus chuckled. "There's only one trouble with it. It won't work."

"I'd like to know why not," Dilbow demanded.

"Well," Gus explained, "if it did work, that would be perpetual motion, and there isn't any such thing."

"Wouldn't this motor drive the car?" Dilbow asked.

"Certainly," Gus agreed. "Until the battery ran down if there weren't anything else to stop it."

"Wouldn't this dynamo charge the battery?" Dilbow insisted.

"It surely would if you kept it spinning at the right speed," Gus admitted.

"Then," snapped Dilbow, "what do you mean by saying the idea won't work?"

"For the simple reason," Gus explained, "that electric energy is just like water power or steam power or any other kind of power. It takes more power to pump water up hill into a tank than you can get back again by letting the water run down through a turbine.

"What do you think would happen if you made an auto like that drawing? When you turned on the juice, the car would start because current would flow through the motor, but if you put in a dynamo or generator big enough to make as much current as the motor uses, it would take more power to drive it than the motor would produce. The car would start all right, but the minute the generator cut in, it would stop as though you'd slammed on the brakes."

"If that's so," Dilbow interrupted, "then how do they get away with such small generators on automobiles? Isn't that generator," he added, pointing to the one in the car on which Gus had been working, "as small as the self-starter and doesn't the self-starter motor have power enough to turn over both the engine and the generator at the same time? And doesn't it keep the battery charged?"

"Listen, mister," Gus said, "you can't judge a book by its cover. And you can't judge how much power a generator will take or a motor will give by its size.

"The self-starter motor on a car is a specialized job. It has to develop as much as a half horse power or more for just a few seconds of time and it has to do it on only six volts of electrical pressure. To get that result, the armature is wound with solid copper bars and the field with a few turns of heavy copper ribbon. Then there are four copper brushes with a wide commutator. When you press the starter button, the juice flows through the starter motor in a regular flood. Maybe as much as three or four hundred amperes go shooting through the starter motor windings for the fraction of a second it takes to 'break loose' a cold engine. Even after the crankshaft starts to turn, maybe seventy-five to a hundred and fifty amperes keep on flowing until the ignition takes hold. No starter motor could stand that load for long. The only *(Continued on page 100)*

GUS says:

Because a spark plug has fine insulation, clean cut threads, and ample spark points, it does not follow that it will give even fair results in your car. What counts is the design of the plug. Some plugs are made to run hot, others medium, some cold. Put a cold running plug in a cold running motor and it's sure to foul if there's the least bit of excess oil. Put a hot running plug in a hot running motor and you get pre-ignition knocks. Sometimes if the cylinder and rings are in good shape, plug fouling is cured with a hotter running plug.

THE HOME WORKSHOP

SCALE MODEL Motorboat

Planes Over Water at High Speed

By
William Jackson
Naval Architect and Designer of the POPULAR SCIENCE MONTHLY Boats

DRIVEN by three sets of rubber bands, this little motorboat hull—a scale model of the POPULAR SCIENCE MONTHLY *Vagabond*—attains an astonishing speed. It planes on top of the water exactly like a large speed boat and skims along for more than 100 ft.

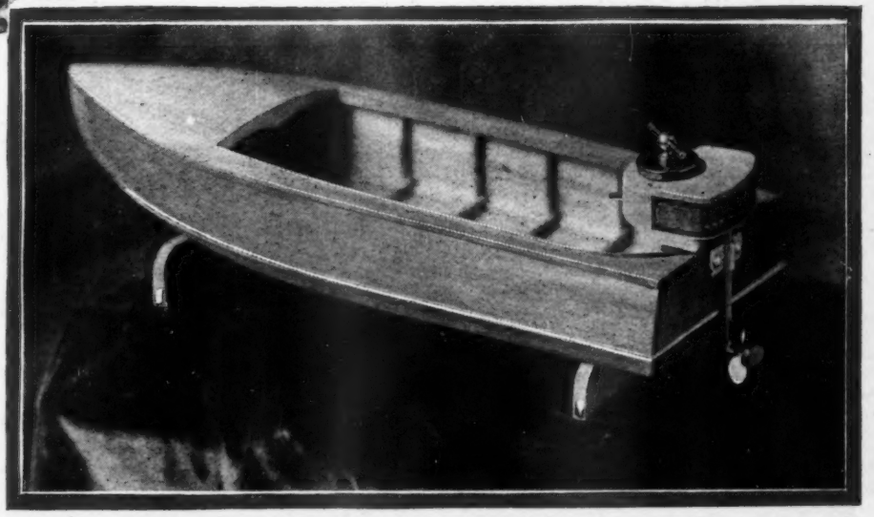
When powered by a spring-operated toy model of an outboard motor such as that shown in the illustration at the right, it will run about 200 ft. at a speed of from 4 to 5 miles an hour.

The hull is a ⅛-in. scale model of the 13-ft. *Vagabond*, a combination rowboat-motorboat that many readers have built with great success (P. S. M., Mar. '32, p. 75, and Apr. '32, p. 82). The over-all length is 19 11/16 in., the extreme beam 6¾ in., and the weight 8½ oz. If a rubber band motor is used, either two or three sets are required, and these should consist of seven strands each.

The framework should be constructed of spruce, and for the planking material use clear 1/32-in. white pine, cedar, or mahogany. The bottom may be pine or cedar, and the sides and deck mahogany.

Draw full size paper patterns of the frames, transom, and stem; then mark and saw out the frame parts. Lay the frame material on the patterns so as to conform to the outline, and glue together with waterproof casein glue or a quick drying nitrate base cement.

The completed frames are next notched for the keel, chines, and inwale. The stem is glued and attached to the keel with two ½-in. brads. Mark on the keel the correct spacing for the frames.



This trim looking, speedy little model is slightly less than 20 in. long and 6¾ in. in extreme beam. It weighs only 8½ oz. and may be driven by a toy outboard motor or by rubber bands

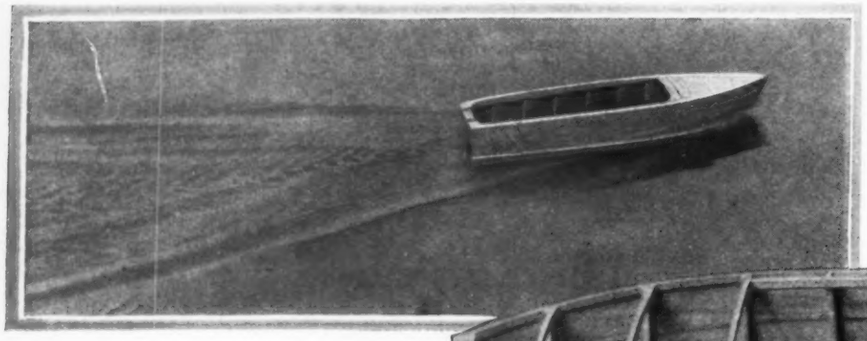
It is necessary to make a form on which to assemble the framework. This form is shown at the bottom of the drawings on page 62. When it has been set up in a convenient place to work, fasten the keel temporarily to it. The various frames are then glued and fastened from the inside to the keel with one ½-in. brad to each frame. Be sure to level and line the frames up before the glue sets.

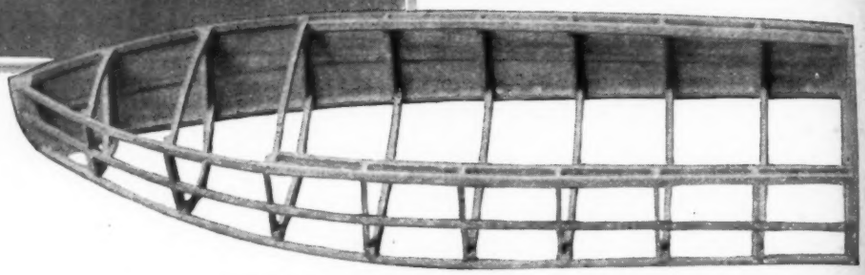
Starting at the transom, glue and nail the chines to the frames. Drill lead holes for the brads. Fasten the chines on both sides simultaneously. Spring clothespins make excellent clamps to hold the parts in place until the glue dries. Tie the chines together at the stem until the glue is thoroughly set.

The inwales are next glued to the frames, but make sure first that the frames are properly lined up. The after and forward ends of the inwales are glued and nailed with ½-in. brads.

The forward motor hook is bent to shape from 1/16-in. brass rod. Drill the stem and insert the hook as near the top of the stem as possible. Embed the out-

HOW TO CONSTRUCT OUR "VAGABOND" IN MINIATURE





The upper view was snapped when the model was speeding along under the power of its rubber-band motor. The other photograph shows the framing. Note the batten for the side planking

side of the hook firmly into the stem.

Glue the deck beams in place, and temporarily set small wood strips between frames Nos. 4 to 8 so as to prevent undue strain on the frame joints when the planking is applied. The corner brace or knee and the inside coaming are now glued in position.

The planking on the original full size boat was divided into three strakes on each side, and eight strakes on the bottom. To simplify matters, the model is constructed with one 1/32 by ¼-in. batten on each side, and two battens of the same size on the bottom. These are carefully notched into the frames and glued.

The side planks are each attached in one piece, but the bottom planks in four pieces. While the 1/32-in. planking is thin enough to bend easily, it is best to soak the pieces in hot water and bend to the required shape as accurately as possible by hand. When dry, glue the planking to the framework.

Plank the sides first; then remove the hull from the form and carefully trim the projecting edges flush.

On the bottom begin by gluing the two planks nearest the keel. These are cut to shape so that the seams will meet in the center of the bottom battens. Soak the bottom planks in hot water and shape them by hand before gluing.

Fill any defective spots in the seams with a plastic wood composition. Sand the hull smooth and apply two or three coats of varnish or lacquer inside.

Glue the 1/32-in. decking to the deck in two pieces, with the seam in the center. Deck seams may be simulated by cutting faint lines in the deck about ⅜ in. apart.

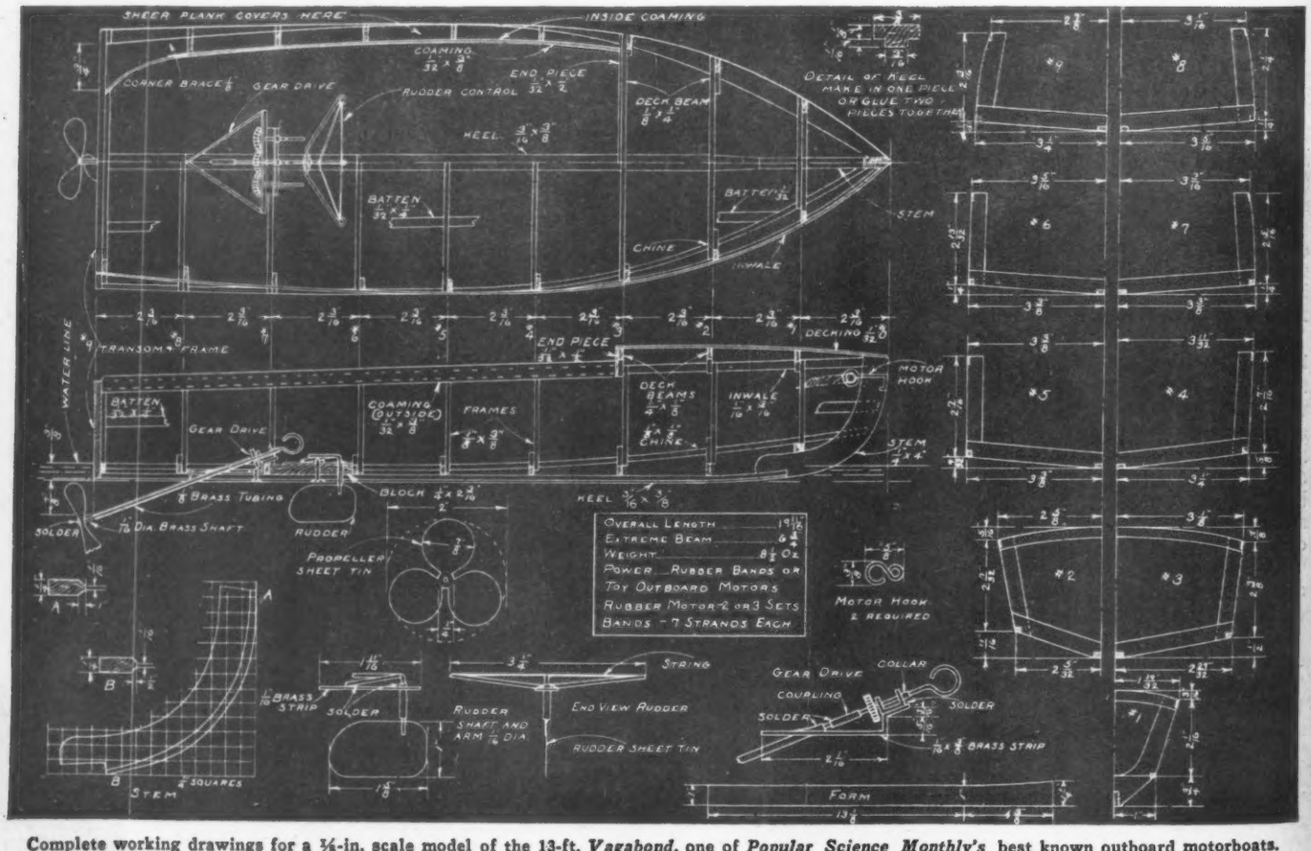
With the decking in place, glue the 1/32-in. coaming, end piece, and sheer plate in position. Allow ⅛ in. of the coaming and end piece to project above the sheer plate.

Moldings 1/32 by ⅛ in. are glued to the sheer to give a finished appearance to the hull and make it look shipshape.

A false outer bow stem 1/16 by ⅛ in. is soaked in water and bent to shape so as to fit the outer edge of the bow. This piece covers the bow and the edges of the planking at this point.

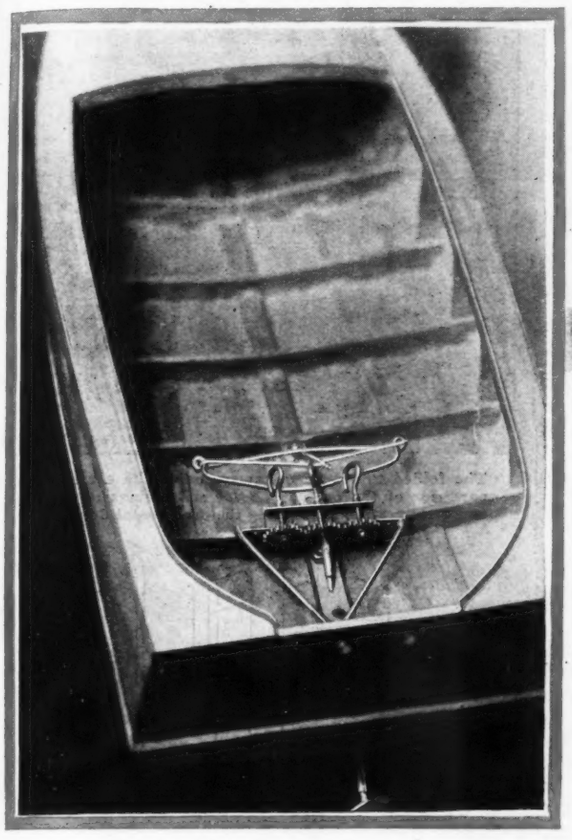
Paint the hull below the water line bright green, and make the ⅛-in. boot-topping white, striping it on as neatly as possible. The remainder of the hull is then varnished. Rub with fine sandpaper between coats.

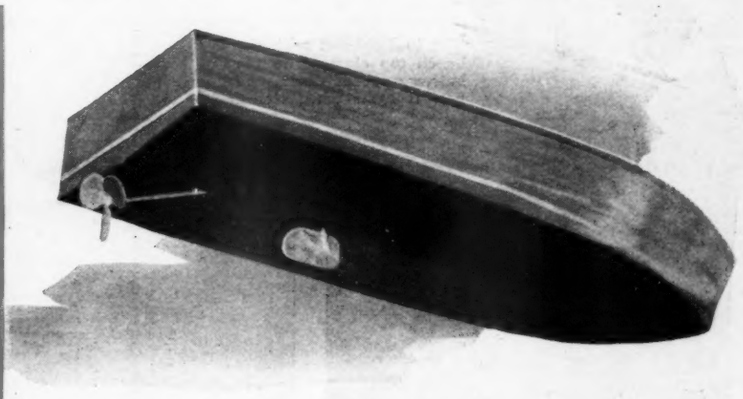
The gear drive is built as indicated on the plans, or the gear assembly may be purchased from a model airplane supply



Complete working drawings for a ⅜-in. scale model of the 13-ft. *Vagabond*, one of *Popular Science Monthly's* best known outboard motorboats. The frames should be laid out full size on paper so that the parts can be cut and assembled accurately. The gear drive can be bought, if desired

FRAMED AND PLANKED EXACTLY LIKE THE ORIGINAL





The underside of the hull showing propeller and rudder and, at left, the gears and rudder control from above. Compare with the details on page 62

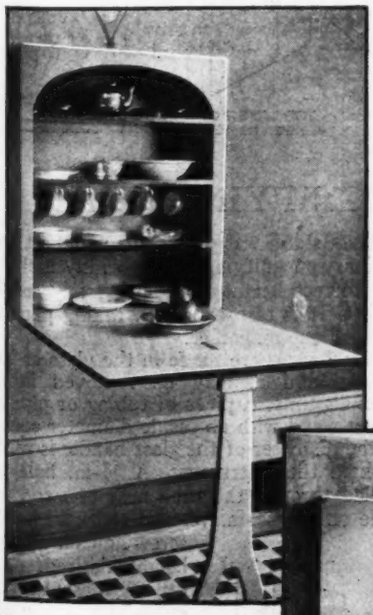
house. The gear assembly is fastened to the keel with one 5/16 by ⅛ in. machine bolt. The rudder assembly is similarly bolted with one ½ by ⅛ in. machine bolt.

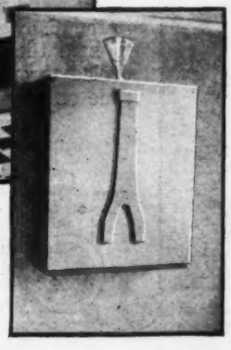
By studying the drawings carefully and doing the work with painstaking attention to every detail, you can learn a good deal about boat building as you construct this little model. In fact, as you progress with the assembling, you will find that it follows closely that of the full size *Vagabond*. Indeed, the operations are essentially the same, only on a larger scale.

You will find it interesting to look up the March and April, 1932 numbers of POPULAR SCIENCE MONTHLY, if you keep a file of back issues as so many home workshop enthusiasts do. The photographs on page 77 of the March issue will show you how the framework for the full size boat was set up, and the illustrations which are shown in the April issue will give you a good idea of the method of planking the hull.

Space-Saving Table and China Closet for Small Kitchen

FOR small apartments or where space is limited, this combination kitchen china cabinet and breakfast table will find favor. It was made of 13/16-in. clear white pine in a home workshop where the only special machine was a jig saw. The dimensions of the cabinet itself —the box part fastened to the wall—are 12½ by 30 by 36 in.; and the door of the cabinet, which forms the table when let down, is 30 by 35 in. The back is a sheet of ¼-in. plywood, screwed securely to the frame and shelves. The cabinet is fastened directly to the wall 29 in. from the floor, giving the right table height.

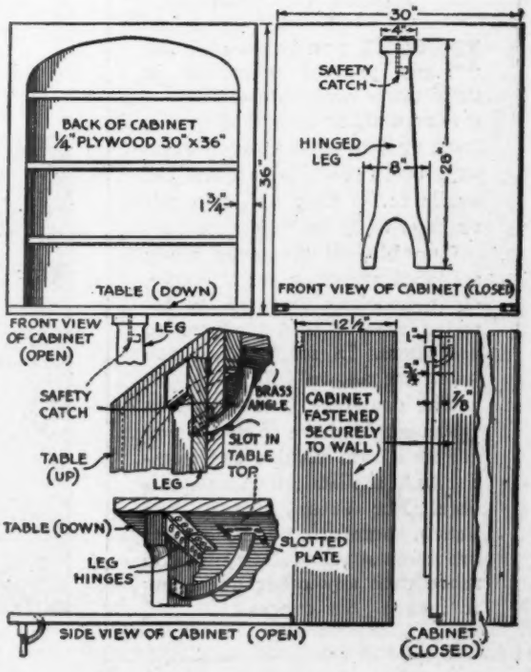




How the combination table and china closet appears when open and, at right, the cabinet closed. An ingenious concealed brass catch keeps the leg firm when the table is down and holds the top up when the cupboard is shut

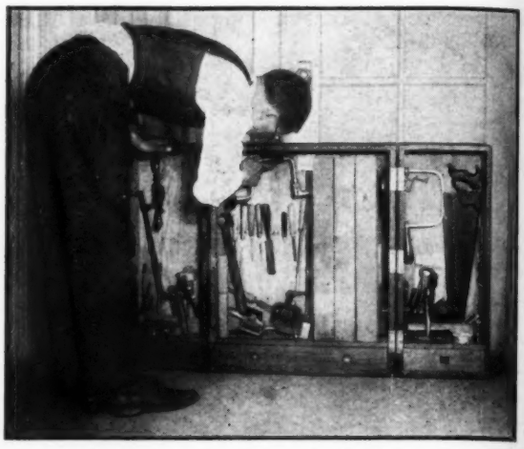
The catch used is of my own invention and serves both as safety catch for the leg when down and a lock for the door when the table is raised to close the cabinet. To release the catch when the cabinet is closed, the lower end of the leg is drawn out, and the table comes down. The leg is then pulled out at right angles to the table top, and the safety catch snaps into place, making the table leg secure. To close the cabinet, the table is raised slightly and the catch pressed to one side, whereupon it slides into the slot through the table. The table is raised to a vertical position against cabinet, but the end of the leg is held away from the top a few inches. Then, when the table is against the cabinet, the leg is pushed against the underside of the table top, thus locking the cabinet and drawing the top tightly into place to serve as the cabinet door. This hooking arrangement, which is entirely out of sight, is a puzzle to the uninitiated.

The inside is orange enamel; the shelves, table, and outside are a light green enamel; and the edges of the shelves, table, and table leg, black enamel. If desired, the top of the table could be stenciled or decorated with transfers.—A. C. JOHNSON.



Bench and Tools Hidden in Carved Cabinet

The tool cabinet with the bench top clamped to the halfway opened doors, and how it looks when closed



The folded top is stored away inside the center compartment of the cabinet. *Below:* Drawings of the top and a suggestion for making the ornamental door panels

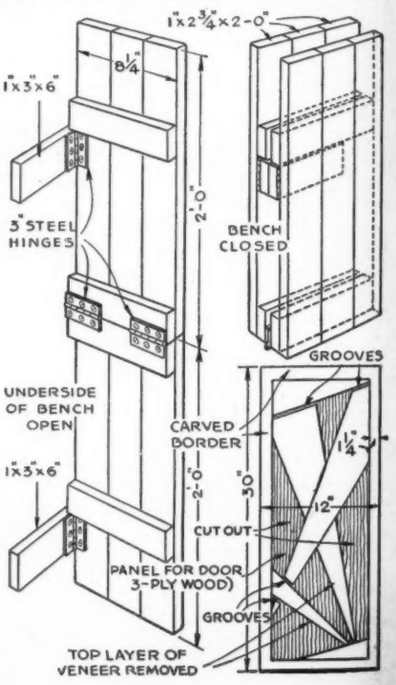
FOR use in an apartment or wherever space is restricted, a unique, compact substitute for a workshop can be made by adding a folding bench top to a tool cabinet of standard design such as has been described before in POPULAR SCIENCE MONTHLY. With a little extra work the whole cabinet can be given the appearance of a decorative piece of furniture.

The bench top, which is 8¼ in. wide and 48 in. long when open, is sufficiently large for the average job done in the home. When folded, it can be stored in the cabinet. Each half of the top is made of three pieces of 1 by 2¾ by 24 in. white pine fastened with cleats, as indicated in the accompanying drawings. The two halves are joined by means of two heavy 3-in. steel hinges. Two cleats 6-in. long are hinged to the front for fastening the bench top to the cabinet doors with clamps as shown in one of the photographs. If preferred, the bench could be attached to the top of the doors with bolts and wing nuts.

The cabinet itself is of oak. To make it more ornamental, additional panels of thin three-ply wood were cut out as in one of the drawings and glued on the doors to give a carved effect. To set back some of the converging rays, certain parts of the panel, it will be seen, were cut away entirely with a scroll saw. Geometric designs were then carved around the 1¼ in. wide borders of the panels, and the top layer of veneer was shaved away from all the remaining surface within the borders, giving a distinctly hand carved effect of a rugged or antique type. The top and sides of the cabinet were further decorated by cutting well-spaced lengthwise grooves.

When the cabinet was ready for painting, an effect of light and shadow was obtained by rubbing off much of the stain on the higher parts.

One of the photographs shows the finished cabinet closed, with a model of the POPULAR SCIENCE MONTHLY Viking ship on top.—CARL JULIAN VETTER.



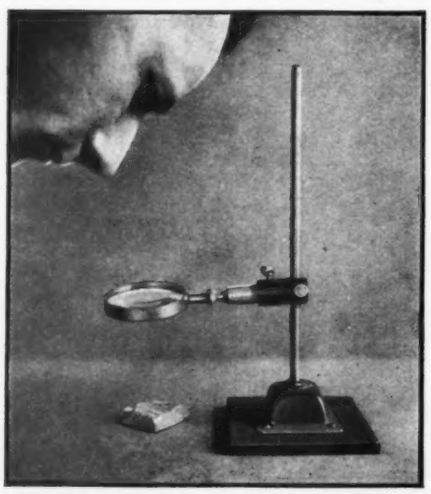
Our BLUEPRINTS Insure Success

BEFORE you begin to build any project whatever in your home workshop—whether it is something described in this issue or not—look up the list on page 80 to see if blueprints are available. If they are, take advantage of them.

Our blueprints cover many subjects, and they are all large, clear drawings so carefully detailed that it is a pleasure to use them. In many cases the parts are shown full size.

The drawings that appear in the magazine have to be sharply reduced both in size and number to fit the limited space available. For actual use at the bench, therefore, our blueprints are much superior. They will do more than any other one thing to insure your success.

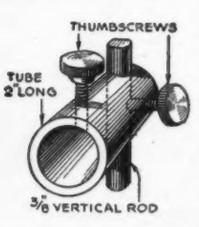
STAND SUPPORTS MAGNIFYING GLASS



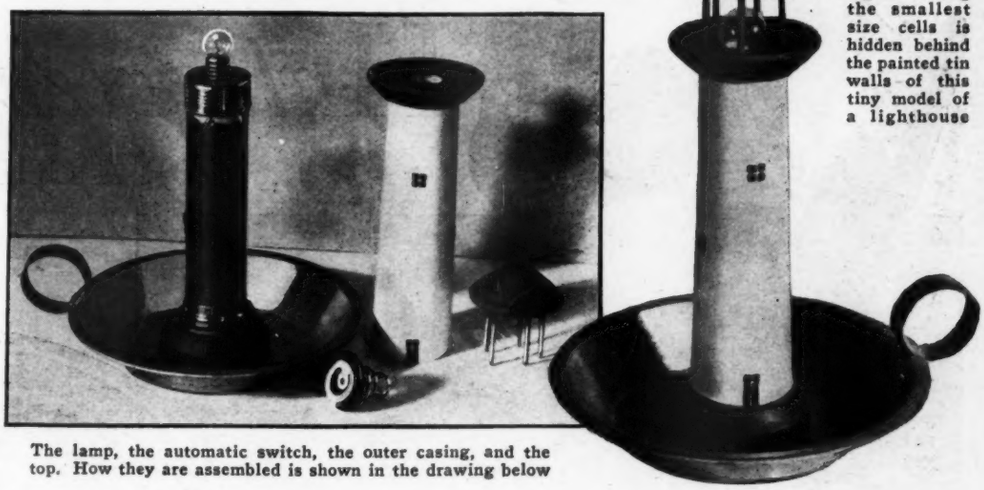
The magnifying-glass stand in use and, at right, a sketch of the simple clamping device

THIS stand was designed to support an ordinary magnifying glass steadily and at the correct height for viewing any small object. It is also an aid in taking photos through the magnifier.

No changes are made in the glass or its handle, and it may be removed in a second's time. A piece of tubing or pipe 2 in. long and with an inside diameter equal to the diameter of the glass handle is used to hold the instrument. A ⅜-in. hole is drilled through the tube near one end to slide on the ⅜-in. vertical rod, and a set screw holds it at any height desired. Another set screw secures the handle of the instrument in the tube. The base can be made up of junk-box parts in any way desired.—W. C. WILHITE.



This Little Night Lamp Lights When Lifted



The lamp, the automatic switch, the outer casing, and the top. How they are assembled is shown in the drawing below

An inexpensive pocket flash light having the smallest size cells is hidden behind the painted tin walls of this tiny model of a lighthouse

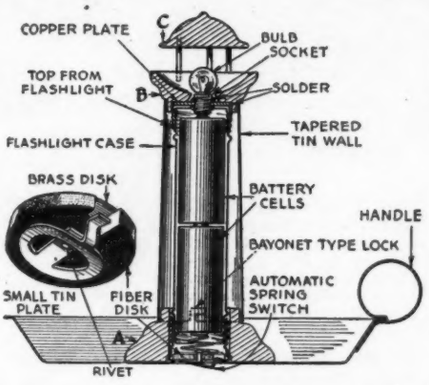
DISTINCTLY novel in design, this night lamp resembles a miniature lighthouse, and when it is picked up a homemade automatic switch in the base causes it to light. To make one like it requires only an inexpensive pocket flash light, a tin plate, and a few other small parts.

Obtain a flash light using the smallest size dry cell. Make over the bulb end as shown in the accompanying drawing by cutting off the top, soldering on a washer-like copper disk, and soldering the socket into the disk. Cut a hole in the bottom of the flash-light case and install an automatic switch made as shown. The ⅛ in. thick disk of hard fiber should be just large enough to fit in the base of the flash light, while the round brass spring should clear the edge of the cut-out hole by 1/32 in. when riveted in place. Remove the side switch regularly furnished. If the flash light has a fiber tube, solder a copper wire or strip connection between the top and the bottom metal parts.

The wooden parts, *A*, *B*, and *C*, can be made easily in a lathe, or they can be shaped without difficulty from pine with a sharp knife and a file. The supports for the roof are firmly set in part *C*, but make a sliding fit in the holes in part *B* so the roof may be removed to change the bulb.

A round hole is cut in the 6-in. tin pie pan or plate for the switch spring to pass through, and a ½ in. wide handle is soldered on. The part *A* is then attached with brads.

For the "walls" of the lighthouse, prepare a very slightly tapered cone of tin and trim the shoulders of the wood parts to fit. This part can best be made by first whittling or turning a tapered wood form and cutting a piece of lightweight tin to fit around it exactly, the edges meeting in a butt joint. Wire the tin around the form, solder the joint, and file off the excess solder and wire. The tin may then be slipped off the wooden form. Brad the top of this tin casing securely in place, but key the bottom with a fastening of the bayonet socket type, as indicated, so the cells will be accessible for changing them.

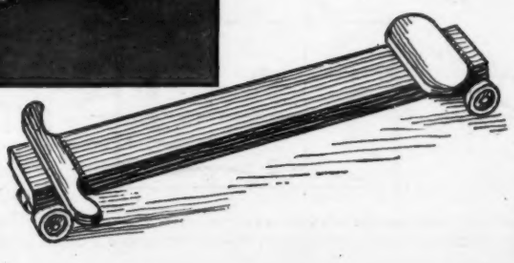


Assemble the parts and adjust the spring so that the weight of the lamp will break the contact it makes with the rim of the metal piece at the bottom of the flash-light case and thus put out the light. When the lamp is picked up, the spring again makes contact and completes the circuit through the dry cells and bulb.

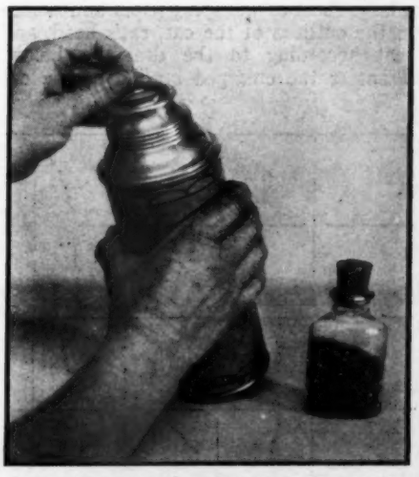
Paint the casing white and the base and other wooden parts green or brown. The windows and doors are painted with black enamel, while the tin plate with its handle are given two coats of copper colored "bronze" paint. If a small quantity of luminous paint can be obtained from a jeweler or watch manufacturer, a little may be applied near the handle to make the lamp easy to locate at night.—E. A.

SKATE TRAPEZE GIVES BOYS EXERCISE

THIS muscle building and fun giving pastime requires merely a "skate-mobile," minus the proverbial soapbox, and a couple of hand rings suspended from the floor beams in the basement. Seat and foot rests are attached to the coaster. The game consists in sliding the coaster backward and forward rapidly from one ring, and then catching the other ring and repeating the whole operation.—REEVE PRATT.



It takes more skill than it looks to operate this amusing exerciser, but an occasional spill only adds to the zest. The boy who thought of this device is the eight-year-old son of J. G. Pratt, of Washington, D. C. a regular contributor and one of the greatest experts on photomicrography



REMOVING ODORS FROM A VACUUM BOTTLE

AFTER it has been thoroughly washed, a bottle of the vacuum type for keeping liquids hot or cold can be freed from any slight sour odor that remains by dropping one or two crystals of potassium permanganate into it. By oxidation, the crystals will "sweeten" the bottle, but it should be washed again before being used.—R.B.W.

Jig-Sawed Parts Form Unique *Halloween Rocker*

FOR A CHILD'S ROOM

By Morton C. Walling

Here is a rocker that will appeal to the imagination of any little boy or girl because it has a picturesque, story-book quality. It can easily be made on a small power scroll saw

TWO life-size black cats with backs arched and tails raised in true Halloween fashion form the sides of this novel jig-sawed rocker for a child's playroom or nursery. Designed for a four- or five-year-old child, the chair is 20½ in. high and 12⅞ in. wide over all. However, the same design can be used within reasonable limits for a larger chair simply by increasing the dimensions.

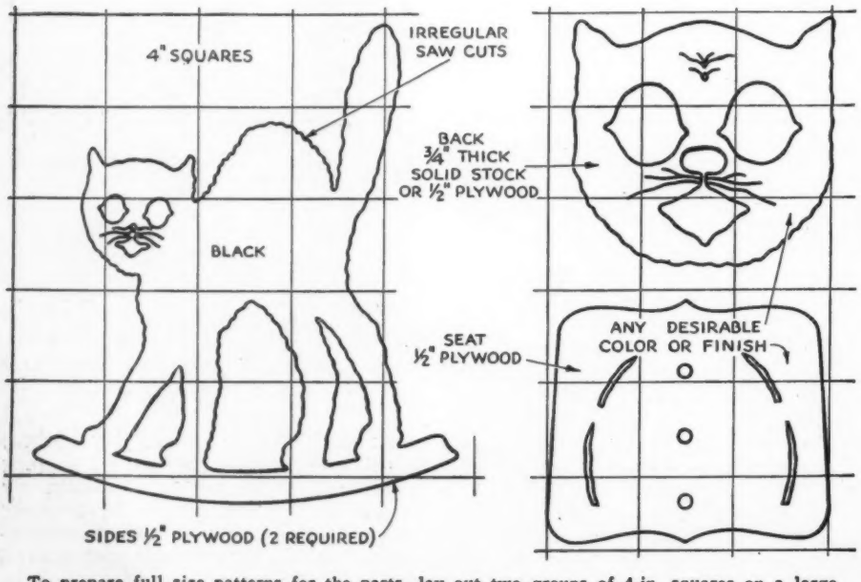
In constructing the chair, the writer used ½-in. five-ply wood for the sides and seat and a piece of ¾-in. solid stock for the back, but ⅜- or ½-in. plywood can be used throughout, if desired. If solid stock is used for the back, plan the outline so the grain runs crosswise.

First, lay out full size 4-in. squares on a large sheet of wrapping paper and sketch in the outlines of the cat, cat's head, and seat according to the drawings below. Transfer the enlarged outline of the cat to one piece of plywood, place this on top of the stock for the other side, and drive thin brads in the scrap areas to hold the two pieces together. By doing this, both cats can be sawed out in a single operation.

When all the outlines have been transferred to the stock, drill holes in the inside scrap to take the saw blade for the start of each cut. In sawing the outlines of the sides and back, shift the work slowly from one side to the other to give the finished pieces an irregular furry appearance. The whiskers on each cat can be formed by making single-width cuts.

In making a small chair of this type, sufficient strength can be obtained if it is assembled with glue, screws, and four angles—the screws being used to hold the back in place and the angles being used to support the seat. If mortise and tenon construction is desired, allowance for two tenons on each side of the back and seat should be made when cutting the stock. Since a tight fit is important, make the tenons slightly large at first and then trim them to fit the mortises cut in the sides.

With the exception of the two cats, which look best painted black, the question of finishing is a matter of personal preference. In contrast to the black sides, the writer found a red back and seat to be effective. Two coats of paint, one before assembling the parts and one after, will prove sufficient.



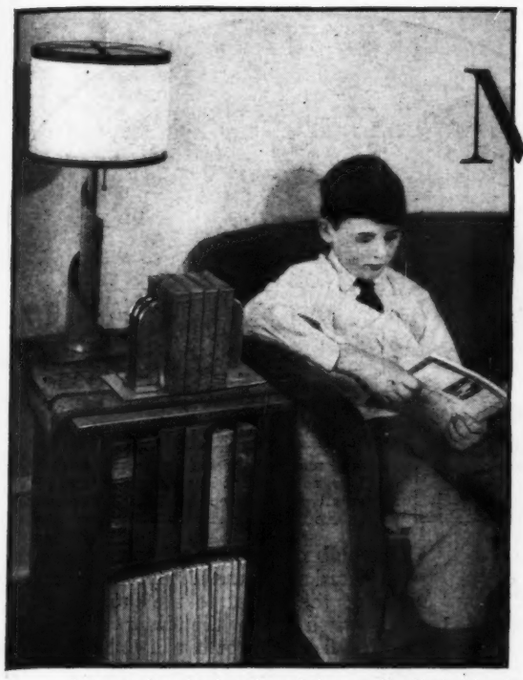
To prepare full size patterns for the parts, lay out two groups of 4-in. squares on a large sheet of wrapping paper as shown above and copy the three designs carefully, square by square

HOW TO GIVE WOODWORK A CRACKLE FINISH

A COLORED "crackle" finish similar to that found on some metal cameras can be given to wood by applying a concentrated water solution of magnesium sulphate to which coloring material and sufficient dextrine to give it the consistency of varnish have been added. The solution is spread on with a brush and on drying forms into beautiful crystals. If the wood is extremely porous, it should first be given a coat of glue size.—K. M.

COSTLY LOOKING
Modern Book Ends and LAMP
Made from Copper and Brass

By
EVERETT EAMES



These unique book ends and the equally distinctive lamp are an example of what can be done in the home workshop with inexpensive materials. The end table, too, is homemade

TAKEN in the plain form in which they come from the mill, ordinary copper and brass plates, bars, and sheets lend themselves readily to the fabrication of articles of modern design with a minimum of cutting and shaping.

The pair of book ends illustrated are each made of three flat plates and three bars. The bottom plate is ⅛ by 3 by 4½ in.; the plate resting on the bottom is 1/16 by 1¾ by 3 in.; and the vertical plate is 1/16 by 3 by 3¾ in. The bars are all 3/16 by 1⅜ by 5 13/16 in.

First cut the parts with a hack saw, file the edges (rounding the top of the bars as shown), and smooth them with emery cloth. Apply a spot of solder on each of the two bottom plates, lay one on the other, and set them over a gas flame. When they are fused together, cool them with a wet cloth. "Tin" the edges of the base and vertical piece and then hold them carefully in position with pliers while soldering. Care must be taken that the first joint is not loosened.

The three vertical pillars can be attached with solder or machine screws as desired. If solder is used, first thoroughly clean all parts, then tin the joining edges of the pillars and apply flux to the bottom and vertical plates. Next place the parts and hold them over the gas flame, handling them with pliers and a wet cloth as shown in one of the accompanying photographs. If machine screws are used, the holes in the pillars can be tapped to take the screws, or the screws can be made to cut their own threads by forcing them into holes drilled slightly smaller than the outside diameter of the threads. Polish all surfaces with emery cloth, rubbing in one direction only.

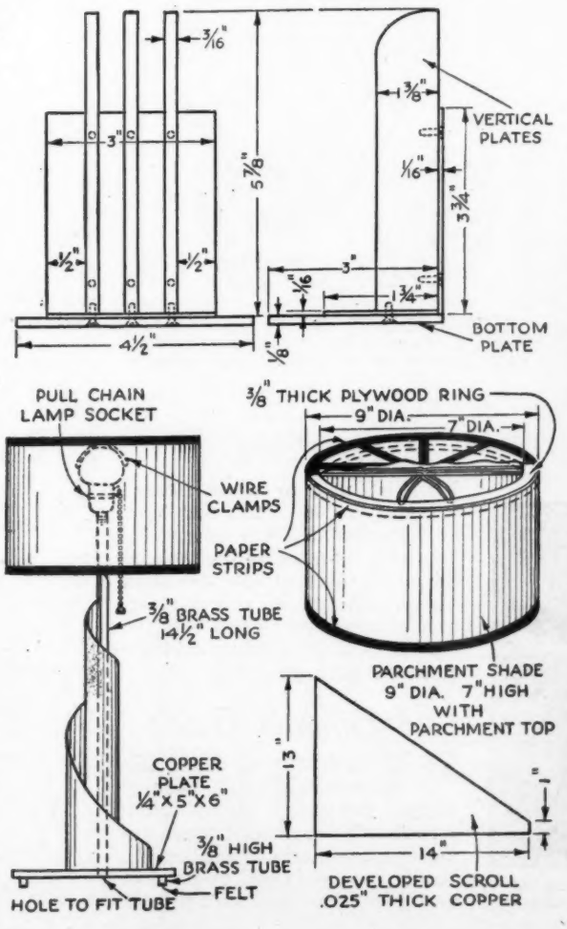
The lamp may be either copper or brass. The center brass tube can be obtained at an electrical supply house with a thread cut on one or both ends. First solder four small pieces of tubing to the base plate; then solder the tube into a drilled hole in the base, testing with a square to make sure that it is vertical.

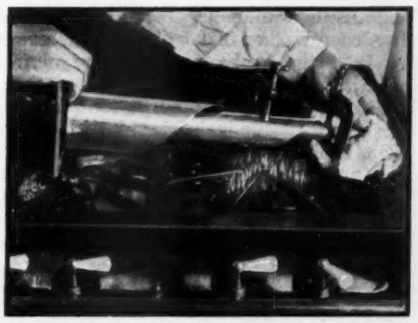
The metal scroll is cut as shown from soft copper or brass sheet about .025 in. thick. Roll it around a broom handle and then unroll slightly to obtain the effect illustrated. The scroll should be soldered at the top to the center tube.

A pull-chain lamp socket should be screwed to the center tube, and a lamp cord passed through the tube. The short legs should be filled with wood composition and have felt cushions glued on.

The shade is of special design to harmonize. It should be made of plain, mottled yellow parchment paper obtainable in stationery stores. Cut out the plywood ring and to it attach a bulb holder from an old shade. Tack the parchment to the ring and fasten the ends together with rivets made from small pieces of copper wire. Tack a disk of the paper to the top, and trim with strips of black paper.

The completed standard should be well polished and coated with clear lacquer.





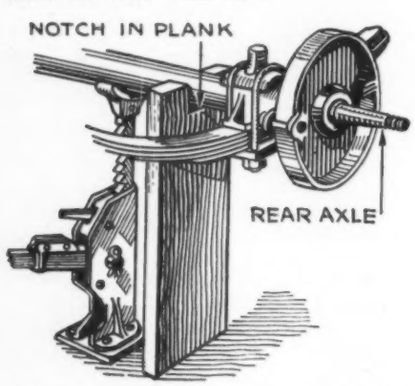
Small clamps hold the scroll to the central pipe of the lamp while the joint is soldered

How the book end parts are held in position over the flame with pliers and a damp cloth

Timely Hints *for* Car Mechanics

Locking Brace for Brake Pedal

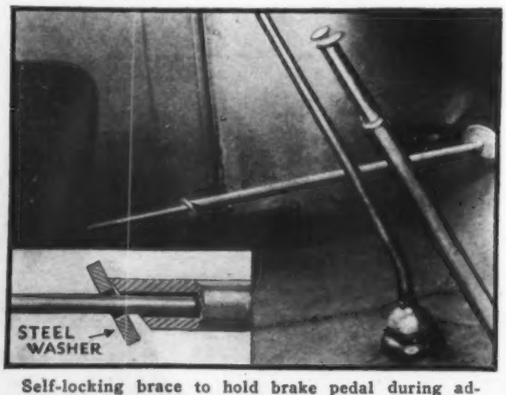
WHEN one wheel has been removed for repairs, a car can't slip off the jack if the simple auxiliary support illustrated below is placed beneath the axle. This support consists of a length of heavy plank or two by four notched at its upper end to receive the axle. The length of the support is determined by the distance from the ground to the axle when the wheel runs free.



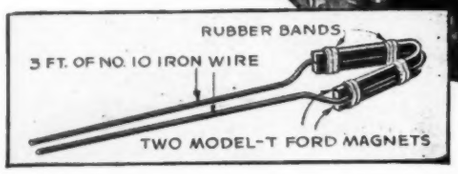
A heavy piece of plank with a notch cut in the end makes a safety support when wheel is off

Brake Pedal Brace

AN ADJUSTABLE, self-locking brace made from a piece of one-half-inch-diameter steel rod, a length of seven-eighths-inch diameter steel pipe, and a hardened washer makes it a simple matter to hold the brake pedal in any desired position while adjustments are made to the brake rods or drums. A fourteen-inch rod and a twelve inch long pipe have been found suitable for the average car. In use, the brake pedal is pushed down and the square end of the pipe rested against the top of the pedal. The steel rod is then pulled out until its upper end rests against the base of the driver's seat and the washer is pressed against the angle at the end of the pipe.



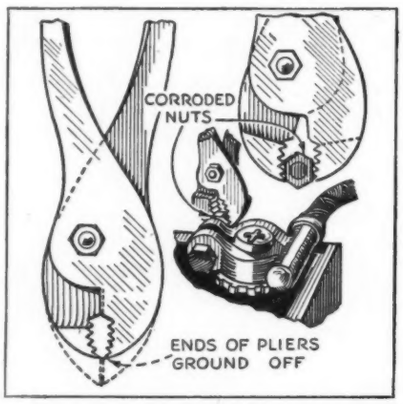
Self-locking brace to hold brake pedal during adjustment is made of steel rod, pipe, and washer



Two old magnets from a Ford fitted with extensions, as shown at left, can be used to pick up small parts dropped into inaccessible places around the motor as illustrated above

Using Old Magnets

TWO discarded Ford magnets, supplied with wire pole extensions in the manner illustrated, form a valuable tool for retrieving small parts that drop into hard-to-get-at places around a motor. The magnetized extensions can be slipped into small openings without difficulty. A better job can be had by binding the extensions to the magnets with copper wire and by supplying an iron keeper to be placed across extensions when the magnet is not in use.



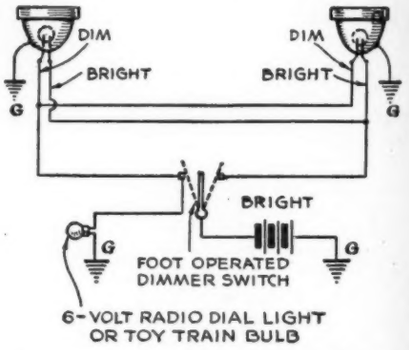
Grinding the ends of plier jaws to sharp curve permits use on corroded cable clamp

Better Pliers

PLIERS used to adjust storage battery cable clamps that have become corroded can be greatly improved by grinding the ends of the jaws to a sharp curve as shown above. Altered in this manner, they can be forced down over the nuts with little difficulty and the teeth will get a good grip.

A Dimmer Guide

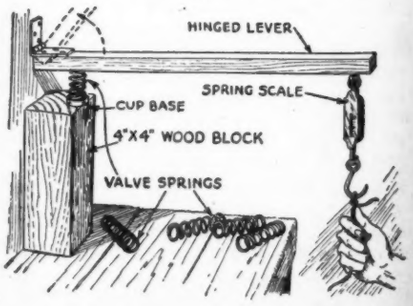
WHEN driving an automobile equipped with a foot-operated dimmer switch, it is often difficult, especially when a car is approaching you, to determine whether the headlights are bright or dim. A good plan is to place a small flashlight bulb of the five-cell type under the dashboard and connect it from the dimmer side of the circuit to the ground. When the switch is on the dimmer side, the lighted flashlight bulb will tell the driver at a glance that his headlights are dimmed and not blinding approaching drivers.



Tiny bulb placed under the dashboard can be connected to show if lights are dim or bright

Testing Valve Springs

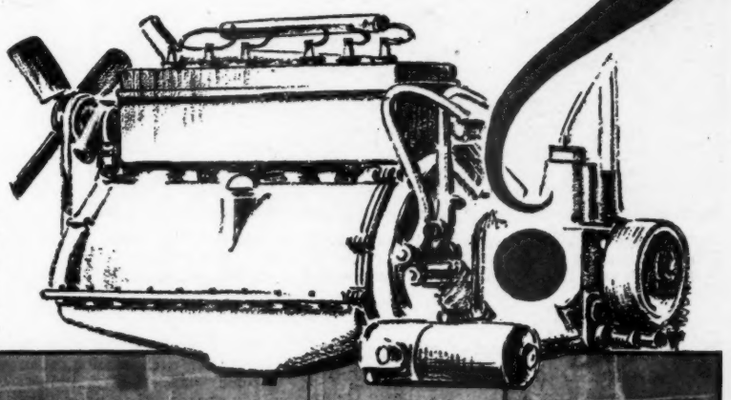
RELATIVE strength of valve springs can be determined by means of a simple compressing lever and a small spring balance. The lever is hinged to a wall above a stationary block. A small spring balance is attached to the outer end of the lever. To test a spring, place it on the stationary block, pull the lower end of the balance until the valve spring is compressed to almost its fullest amount, and then note the scale reading. Any valve spring whose scale reading varies greatly from the average of the set should be discarded and replaced with a new one.



Relative strength of valve springs can be ascertained with lever and balance as shown

What Use Can You Make of an Old Auto Engine

A first prize of twenty-five dollars and seven other cash awards offered for ways to utilize discarded motors



Every old automobile motor is a possible power plant for the lightening of human labor

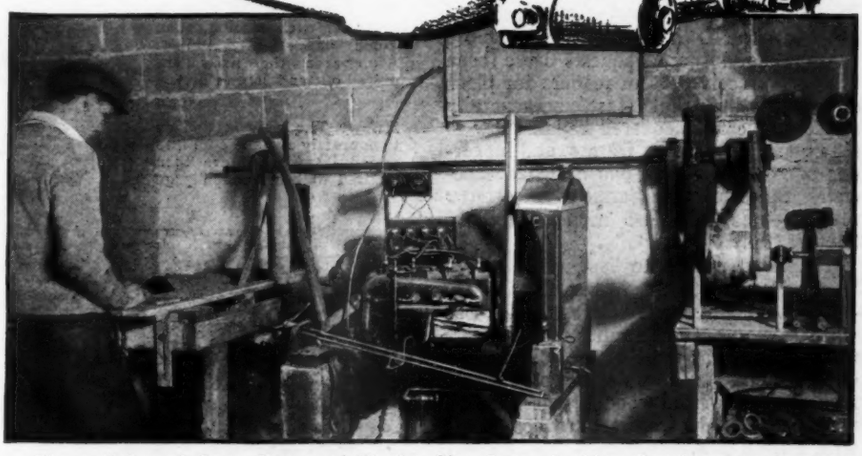
LACK of electricity in his home in Charles City, Iowa, did not deprive Oscar Immer, an ingenious reader, from enjoying the conveniences of a modern motor-driven home workshop. An old automobile engine mounted as shown in the accompanying illustrations solved his problem for a total cost of $10.

Can you think of other ingenious and practical ways to install and use a discarded auto engine in the home or shop, on a farm, or in a boat? Perhaps you have a definite idea and may even have gone as far as to draw up plans. To bring out practical suggestions along this line and make them available to other readers who may have similar problems, POPULAR SCIENCE MONTHLY offers eight prizes for the best ideas on uses for discarded automobile or motorcycle engines. The prizes to be awarded are as follows:

First Prize	$25
Second Prize	15
Third Prize	5
Fourth to Eighth Prizes $1 each	5
Total	$50

If you have a practical suggestion on this subject, sit down and sketch it out. Then write not more than 500 words describing the installation and tell how you would mount the motor in the most workmanlike and economical way. The drawing showing the arrangement need be nothing more than a simple pencil sketch so long as it shows clearly the application of the auto or motorcycle engine.

It is not even required that you actually are using a motor in the manner you describe. Of course, if you have already put your idea into practice, you may enter the contest, adding any improvements that have occurred to you. In this case it is suggested that you supplement your entry with a photograph or two.



The workshop of Oscar Immer, of Charles City, Iowa. Lacking electric power, he set up an old auto engine to drive his lathe, saw, and other machines, which he made himself

Entries in this contest should be mailed before November 1, 1932, to the Auto Engine Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. The judges of the contest will be the automobile and home workshop editors of POPULAR SCIENCE MONTHLY. Their decisions, which will be final, will be based on the ingeniousness and practicability of the ideas entered. In the case of ties, each tying contestant will be awarded the prize tied for. Only one idea may be submitted by each contestant. This contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families.

You will see at once that the possibilities in this contest are almost unlimited in number, the use to which Mr. Immer put his old engine being only one of many. A study of this particular installation and use may, however, aid the reader in planning his own.

The automobile engine, which is from a model-T Ford, is mounted on two reënforced concrete supports so that the main shaft is at a convenient height for coupling in the main drive of the pulley system. To lessen vibration, wood blocks were placed between the motor and the concrete supports.

The original housing, cut off just back of the rear bearing on the motor, acts as the front bearing for the pulley drive shaft. The other bearing is of the pillow block type supported by a wooden bracket which is fastened to the concrete wall with lag screws.

To lessen vibration in the system still more, the wooden pulleys on the machines were assembled in such a ratio as to allow the engine to operate at its slowest practical speed and still deliver the required speed at the machines.

A small pipe brings the gasoline by gravity feed from a tank hung on the outside wall. The exhaust is carried outside through a length of ordinary automobile exhaust pipe. Because of leaky pistons it was also found advisable to replace the breather cap on the crank case with a small pipe arranged to lead the crank case gases outdoors.

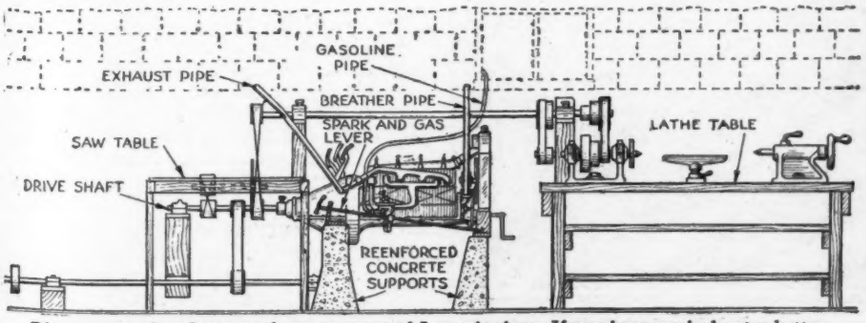


Diagram showing the general arrangement of Immer's shop. If you have worked out a better solution for this problem or can suggest another use for a motor, enter it in the contest

JACK HAZZARD tells how to complete the framework of

Our Speedy New Canvas Covered KAYAK

The kayak is 16 ft. long, has a beam of 27½ in., and is 11 in. deep amidships. It weighs about 35 lb. ready to launch, but will hold two men with light camping gear or one with full cruising equipment

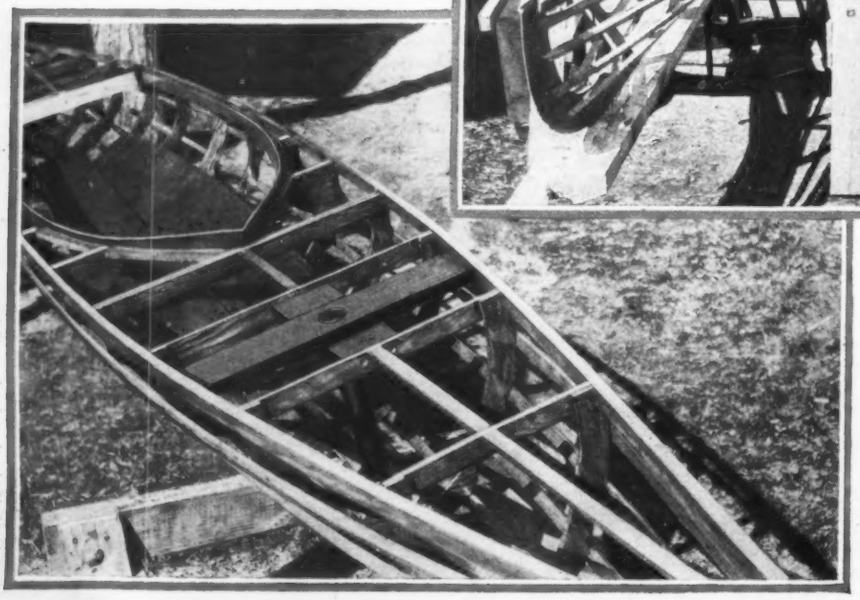
WITH the growing popularity of the Eskimo type of canoe, more and more requests have been received from readers for plans of an easily built, light, fast, and generally serviceable canvas covered kayak. How to set up the keel, stems, frames, and longerons of such a canoe—one designed especially for POPULAR SCIENCE MONTHLY readers—was told last month (P.S.M., Sept. '32, p. 57).

The next step is to fasten the wales. These are let into the frames from ½ to ¾ in. While cuts have been made for this when sawing out the frames, adjustments must be made as most of the joinings are on the slant. Tie the wales in position and make an improvised wooden gage block to aid in marking the frames. Saw the notches with a hack saw.

Tie or clamp the wales in position and check for imperfections in the sheer. A level laid across the frame is a good check at each station, but it is hard to beat the eye, provided a sufficiently distant point can be had from which to survey the job. The wales are secured with 2-in. screws driven into the ends of the carlines and glued.

The longerons are tied in place at each station, then glued and lightly nailed. Afterwards the nails are pulled out and screws driven

Below: The wale is tied on temporarily and the cuts into which it is to fit are then marked with a wooden gage



The framework from above. Note the mast step and the cockpit coaming. The forward ends of the coaming must be steamed before they are bent, and fitting them requires careful work

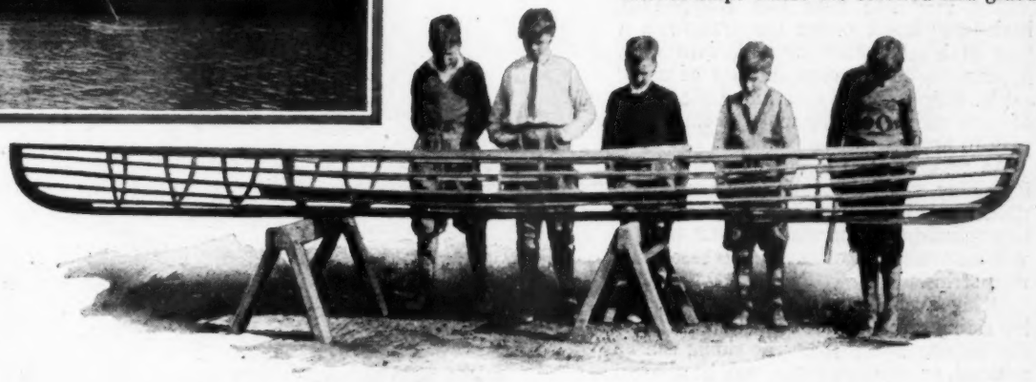
Because the wales are larger than the longerons, more care must be exercised to keep them from splintering when bent, and it might be better to steam them. If this is decided upon, a large inner tube or a length of downspout pipe makes an excellent substitute for a more formal steam box. A half kettle of water boiling hard will furnish enough steam for the job in about forty minutes. Stuff the end of the pipe opposite the kettle with old rags loosely to allow the escape of water caused by condensation.

The outwales are cut from ⅞ by ¾ in. spruce, the greater dimension being used in the vertical and the grain running through perpendicularly. The middle 4 ft. is left full size while the ends, each 6 ft. long, are tapered from the bottom to within ½ in. of the top and from the outer face to within ½ in. of the back.

Mark and cut the bottom taper on one end of one wale; then, using this end as a template, mark and taper an end of the matching wale. Use this second tapered end as a template by which to mark the untapered end of the first piece. Mark and taper the faces in the same manner, and work away the angles where the tapers run into the square portion of the wale.

Run a line ½ in. below the upper corner

Hazzard says: "I weigh 155 lb., the other chap 165, and my son 70, a total of 390, and still there's freeboard." *Below:* A sheer plan view of the frame



of the wale all along the 4 ft. center section and plane from the inner upper corner down to the line. Now clamp the wales in position and secure with 1½-in. screws spaced 1 ft. apart to within a couple of feet of the stems. Here 1-in. screws are used, spaced 6 in.

It will be necessary to saw away the temporary carlines at stations 6, 7, 8, 9, and 10 to clear the way for the cockpit coamings, the forward ends of which must be steamed. At station 11 the side coaming strips run straight back to the reënforced carline. A short piece of coaming is cut to fit snugly between them, and a piece of quarter-round oak is glued and nailed in the corner.

Rest the forward ends of the coaming on the wales and, clamping them in place at frames Nos. 9 and 10, work forward to 9, then 8 and 7, forcing them slightly downward to secure a gradual rise from ¾ in. aft to about 1½ in. at the forward peak. From frame No. 8 forward there is an inward bend and an outward twist impossible of attainment without steaming.

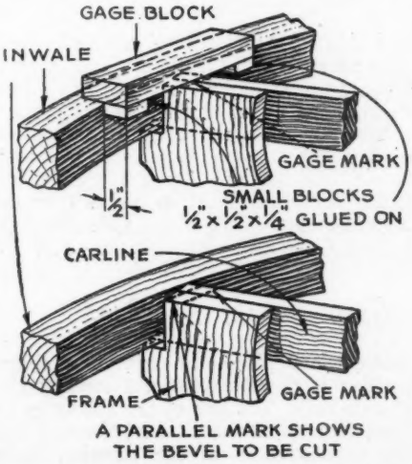
Measure from inside the coaming perpendicularly above the afterface of the carline, horizontally to the center line. This measurement represents half the width of the stem block. Measuring from directly above the center of the carline to the inside of the coaming at the stem gives the fore-and-after dimension of the block; and from the point where these two lines meet down to the upper face of the carline represents the height at the afterside.

Square the end grain of a hardwood block and lay it off for making the stem block. Fasten this block to the end of the starboard coaming, fetch the port strip over to the center line, and mark the bevel as accurately as possible.

To hold the stem block down, make a metal fastening to fit the triangular inner face of the block and rest against the inner surface of carline No. 5.

Once the coamings are fitted, loosen a few screws at a time, insert glue, and tighten the screws permanently.

The mast step is a 1½-in. brass tube mounted securely on a piece of ½ by 2 in. maple, which is screwed and glued to the keel between frames No. 3 and 4 at a point 3 ft. 6 in. from the stem. Bore a hole half through the maple block just large enough to take the tube, and use a plastic wood composition to plug the hole caused by the pilot of the bit. Bore a ⅛-in. hole each side of the keel to let out any water which may get into the step and another in the side of the tube ¼-in. from the bottom.



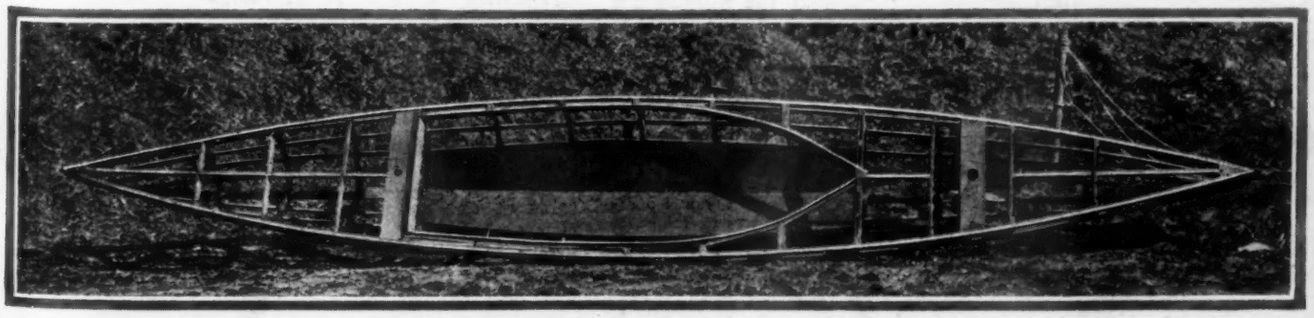
A simply made wooden gage block is used to aid in marking the notches for the inwales

At the level of the wale the tube passes through two pieces of ½ by 4 in. ash, one running fore-and-aft and one running athwartship. These are screwed and glued together and screwed to the wales. To distribute the strain and to provide a beam upon which to tack the decking, pieces of ⅝ by ⅝ in. spruce are fitted, glued, and nailed between the frames along the center line from the apex of the cockpit to the stem head.

To provide a suitable ledge upon which to tack the deck, it is necessary to fit pieces of spruce between the frames and tightly against the outside of the coaming at the level of the wales. Apply glue and nail these pieces to the carlines, and run screws from inside the cockpit.

Frames that show inside the cockpit are sanded smooth, and the cockpit coamings are cleaned and sanded. The 3/16-in. plywood floor boards, which are fitted tightly just over the keel, are screwed in place. At the ends the boards will be about 6 in. in width, but they widen at the middle to almost 10 in. Give the whole frame two coats of spar varnish, preferably of the slow drying type. Rub down between coats only those parts which will be in sight—coamings, inside and out; upper side of floor boards; upper portions of frames Nos. 5, 6, 7, 8, 9, 10, and 11; and floor boards to wale. Make doubly sure to varnish the edges of all plywood frames, turning the canoe over after each coat to touch up places inevitably missed. A quart of varnish will be sufficient.

Next month instructions will be given for covering and finishing the kayak.



The completed framework ready for the canvas covering. The deck stringers, cockpit coaming, and floor boards can be seen, as well as the two mast steps. The after step, however, was added for experimental purposes and is not needed for ordinary use

The latest idea for keeping your home shipshape . . .

Log Cabin Recreation Room

BY USING log siding—boards rounded on one side to look like pine logs stripped of bark—any home owner can transform a part of his basement or attic into what appears to be the cozy interior of a log cabin. Ship-lapped joints along the edges of each strip of siding make it extremely easy to apply.

An unfinished attic is well adapted for log siding, since the wall studs supply the right sort of backing. If the siding is to be applied to a concrete basement wall, it will be necessary, of course, to erect furring strips.

Being available in several widths, the log siding gives a most realistic effect. At the corners of the room the siding can be mitered, or alternate strips may be allowed to jut through to give the interlocked effect of the logs in a real cabin. Stripes of grayish-white wall paint applied to the joints between the "logs" will imitate the chinking. Log siding can also be used in building up the doors.

In planning a basement or attic recreation room, try to make use of existing conditions as far as possible to carry out the cabin design. Attractive casement sash can be substituted for the usual attic windows; and if the recreation room is to be in the basement, leaded glass sash of simple design can be substituted for the ordinary unattractive cellar sash. Should an extra window or two be needed for the sake of appearance and it is not desired to cut in real ones, imitation windows can be placed where necessary. Bookshelves and a fireplace—the latter either imitation (see P. S. M., Dec. '31, p. 98) or real—will add to the effect. If the use of a genuine fireplace is possible, a wood box can be built into the adjoining wall space in imitation of a quaint Dutch oven.

When purchased, log siding is the natural pine color, but several coats of silver gray oil stain will give it a pleasing aged appearance. If desired, a rustic finish can be obtained by using dark brown stain.

Your log cabin recreation room can be made a complete unit in itself by planning ample closet space for the storage of games and bridge tables and fitting up a small buffet closet with an electric grill for preparing midnight suppers.—G. W.

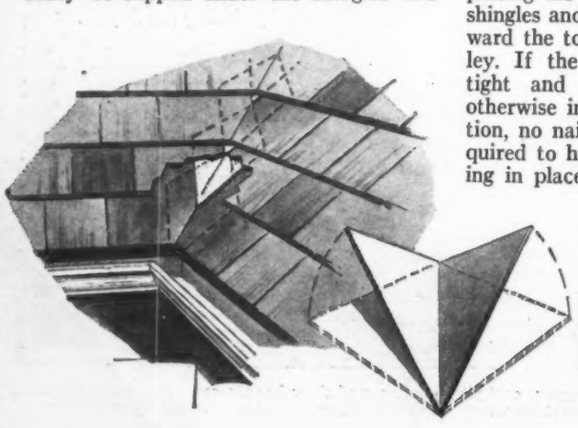
Using paint to give the effect of chinking between the "logs" of an unusual type of basement recreation room

OCTOBER
Shipshape Home SUGGESTIONS

- Clean out chimney and smoke pipe
- Flush steam boiler and water tank
- Insulate steam pipes
- Clean water gage on furnace
- Check radiator valves
- Clean basement
- Repair broken or cracked windows

Special Flashing Strips Stop Leaks in Roof

BY CUTTING and folding sheet copper in the fashion shown below, it is a simple matter to insert new flashing in leaky closed valleys on a shingled roof. The point of the folded flashing piece can easily be slipped under the shingles and pushed into place, the triangular shape making it possible to avoid striking the shingle nails. The size of the sheets to be used depends on the pitch of the roof and the exposed area of the shingles. Start placing the flashing at the bottom row of shingles and work up toward the top of the valley. If the shingles are tight and the roof is otherwise in good condition, no nails will be required to hold the flashing in place.—G. C. B.



How the flashing strips are cut, folded to suit the angle of the valley, and pushed up under the rows of shingles so that one overlaps the other

Drilling Open a Drain

A PORTABLE electric drill and a 3- or 4-ft. length of stiff wire cable can be used for cleaning clogged floor or laundry drains. Ravel about 2 in. of the cable at one end and clamp the other end firmly in the drill chuck. The frayed end will drill through obstructions that will not otherwise yield.—C. P.

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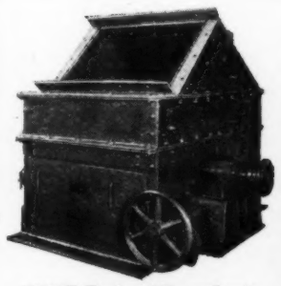
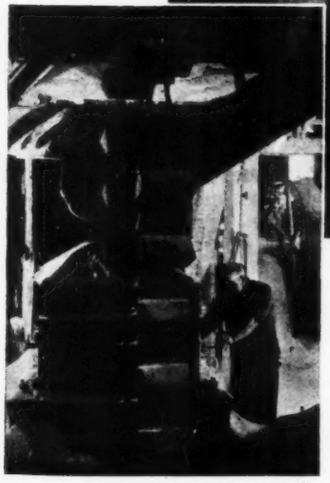
in a BLIZZARD *of* POWDERED LIMESTONE!!



SKF Equipped Pennsylvania Crushing Mill of the type used at the Thomasville Lime & Stone plant, Thomasville, Pa., since November, 1921



SKF Pillow Blocks as shown in major illustration provide a perfect housing for SKF Bearings. They keep oil in and dirt and other foreign matter out.

SKF Bearings in Pennsylvania Crushing Mill Offer Another Outstanding Story of SKF Performance

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These are jobs for bearings that are going to stand up . . . take their punishment . . . and LIKE it. Industry knows the difference between promises and performance . . . where bearings are concerned.

And so, eleven years ago, almost as a matter of standard practice, SKF Bearings went into the Pennsylvania Crusher shown here. In spite of the varying loads to which crusher bearings are subjected . . . in spite of the fact that the SKF Bearings on this job worked in a veritable blizzard of powdered limestone all during that period, the bearings are still in service...still in perfect condition.

SKF Bearings are built to out-perform on the toughest kind of jobs, the brute jobs of industry...so they provide a MARGIN of performance on almost any kind of task to which they are assigned. SKF Industries, Inc., 40 East 34th Street, New York, N. Y.

SKF

BALL AND ROLLER BEARINGS

2911

A PROMISE IS ONLY A PROMISE... *PERFORMANCE* IS HISTORY

Getting a Good Start in Home Movies

By Frederick D. Ryder, Jr.

Indoor movies at night—even in full color—are easily taken. Photo-flood bulbs in your own floor lamps supply ample illumination. Fewer bulbs are needed if special reflectors are used

"THERE are more ins and outs to this home movie game than I anticipated," an amateur photographer told me the other day. "The wife," he went on, "has been pestering me to take movies of the children, and I've agreed to get an outfit. I thought all I had to do was to go buy it. Now I discover there are two kinds of film and so many different kinds of cameras and projectors I'm in a daze. I always thought taking movies was just taking little pictures in wholesale lots, and there shouldn't be anything complicated about that. What kind of an outfit should I buy, and why?"

If you, like this man, are thinking of breaking into the amateur movie game, you ought to get clear in your head the essential differences between the still photography you have been doing and the motion picture photography you want to take up. Of course they're alike in a lot of ways, and what you know about still photography will help you with the other game. But there are important differences in the technique and in what you can and cannot do.

Motion picture photography is, after all, just what its name implies, the photography of motion. A picture of a house or a distant view is no better in the movies than it is in a still picture. On the other hand, a still picture of a child playing may be interesting in a way, but nevertheless it can only be a frozen impression of some fleeting glimpse of the youngster. The movie camera actually records the whole motion with all the cute tricks the kid does with its face, its hands, and its feet. The movie film, in other words, records life, while the still camera only freezes a momentary view of any subject into perpetual immobility.

A lack of understanding of this essential difference probably explains why many movie beginners get uninteresting results out of their first few reels of film. Planting little Willie in front of the camera and letting yards of film grind through the mechanism while Willie gapes into the lens will not produce a film that will hold your friends' attention.

Keep in mind that the motion picture camera is designed to record life and movement and encourage the children or any other human subject to engage in some normal occupation that includes action while you do the shooting.

Another movie mistake that the experienced still photographer is just as likely to make as is the rank beginner consists in making the shots too short. When you press the button to start the mechanism, keep it running for at least ten seconds. A flickering glimpse that terminates before the audience gets a really good look is most annoying.

A third beginner's trick is to wobble the camera or swing it too rapidly. The first causes the picture to jump all over the screen, and the second makes one dizzy to watch.

These are, of course, just samples of the differences in movie technic as compared with still camera photography. As far as the mechanical possibilities are concerned, two vital differences stand out.

First, there is no such thing as doing your own finishing in amateur motion picture photography. You just press the button and leave it to the manufacturer to process the film. This is of interest only to the relatively few more advanced amateur photographers whose chief interest in the subject lies in the work of developing, printing, and enlarging—in other words the chemistry of photography. Amateur movie making will have little appeal for such a man.

Of far more general interest is the fact that amateur motion picture photography offers the only practical and simple way to take pictures of things in full and completely natural color. Recent developments have made this feature of the amateur movie game of still greater importance. Now, with the aid of the new super sensitive color film, you can take full color pictures on slightly cloudy days instead of having to wait for blazing sunlight, as was formerly necessary. Furthermore, the new film is so extremely sensitive that full color movies can be taken indoors at night with the aid of several photo-flood bulbs costing only thirty-five cents each!

The first question for you to decide as a prospective amateur movie photographer is the matter of size. There is the regular sixteen-millimeter film and the new split-sixteen (P. S. M., Sept. '32, p. 27).

You will decide on the split-sixteen film if cost of operation is of paramount importance, because this size film gives four minutes of projection time at a cost of two dollars and a quarter compared with six dollars for the same amount of screen projection with the regular sixteen-millimeter film, or nine dollars if you wish your pictures to be in full color.

Within its projection size limits, the split-sixteen gives virtually as good results as the regular sixteen, assuming cameras and projectors of equivalent grade. But the regular sixteen-millimeter

Photo Contest
AWARDS

FOR the best photograph submitted in our June Photo Contest (P. S. M., June '32, p. 101), J. L. Sandy, of Chicago, Ill., has been awarded the $10 prize. The following won honorable mention in the same contest: George W. Agan, Jr., Herkimer, N. Y.; Joseph Baldoff, Cincinnati, Ohio; Roy E. Bedbury, Seattle, Wash.; G. Cline, Detroit, Mich.; Wilton Fisner, Tulsa, Okla.; George Griffis, Butler, Pa.; Eleanor Harris, Hammond, Ind.; Don McCavick, Cedar Falls, Iowa; Lee McCrae, Pasadena, Calif.; C. O. Mock, Lexington, Ky.; Prescott H. Peirce, Providence, R. I.; T. Schuyler Robbins, Trenton, N. J.; H. W. Schoeppler, Rutherford, N. J.; J. M. Stofan, Garfield, N. J. The July contest winner will be announced next month.

• IT'S SO EASY *to make clear, brilliant home movies with this simplest of home movie cameras. Aim . . . press a lever . . . and that's all. It's as easy as making snapshots.*

The Wonderful Story of Growing Up

Your Movies of it will be your Family's most precious Possession

HOW priceless the living movie record of your baby's smile . . . the first uncertain steps . . . playing in the sand . . . the drama of going to school . . . sports . . . picnics . . . the first party dress or first long trousers . . . milestones on the road of growing up.

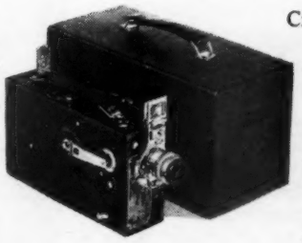
Such movies are so easy to make with Ciné-Kodak. And they are vivid with the reality of lifelike action. A record of your child that time cannot dim—a priceless possession in years to come. And not expensive either.

Ciné-Kodak is as easy to use as a Brownie. Aim . . . press a lever . . . that's all there is to it. Make perfect movies the first time you try. We do the rest, finish the film and return it ready for your Kodascope projector.

Your dealer will gladly show you typical Ciné-Kodak movies. Stop in and see him. Eastman Kodak Company, Rochester, New York.

Ciné-Kodak

Simplest of Home Movie Cameras



CINÉ-KODAK MODEL K

This versatile, all-purpose camera permits quick change of lenses and can be fitted for Kodacolor (movies in full color). Loads with full 100 feet of 16 mm. film.

You Pay No Tax . . . The government has placed a ten per cent tax on cameras and on other articles that you use in your leisure hours. But as all outdoors invites your Ciné-Kodak, this company will not let anything interfere with that invitation. It will absorb the tax. No increase in the price you pay for any Eastman camera.

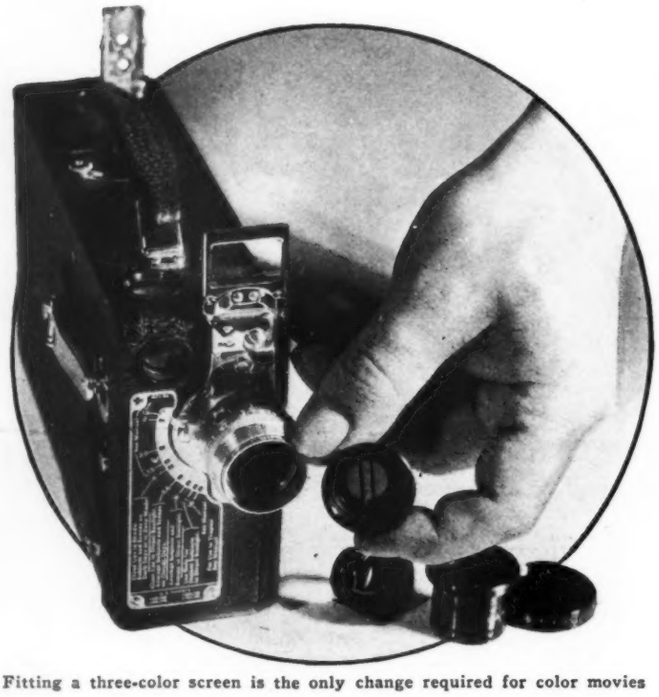
film makes possible much larger and brighter pictures and also pictures in full color, an impossibility with the split-sixteen.

If you have done much still photography, you are quite likely to make the common mistake of considering the camera more important than the projector. As a matter of fact, the quality of the projector is more important because you use it more often. There is no sense in spending nearly all your money on an extra fine movie camera and then have to skimp on the projector and end up with poor pictures on the screen.

Remember that you are almost sure to become interested in commercially produced sixteen-millimeter film subjects, and the success of home entertainment with these films depends on the quality of the projector.

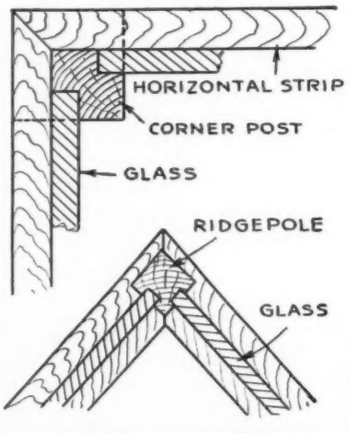
Now about the prices of equipment. You can get either a movie camera or a movie projector for the regular sixteen-millimeter film at almost any price from about thirty-five dollars up to several hundred dollars. If you wish to go in for full color photography later on, then you must have a camera with an F/1.9 anastigmat lens made to fit the special color filter used in exposing the color film. Such a camera will cost you about one hundred and fifty dollars or more. The same applies to projectors. If you want to project full color movies, you must have an outfit made to take the special color projection screen that fits over the projection lens. Such a projector calls for an outlay of one hundred and fifty dollars or more.

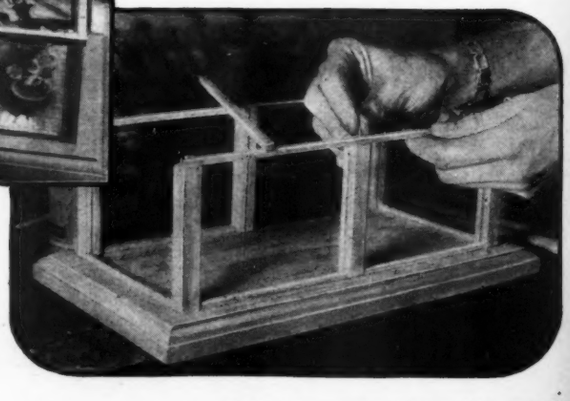
At present there is only one movie camera and two sizes of projectors made for the split-sixteen film. The camera and the smaller projector total a bit over fifty dollars.



Fitting a three-color screen is the only change required for color movies

Real Plants Thrive in This Tiny Toy Greenhouse





The framework is constructed as shown in the detail drawings above and in the photo at the right. The top lifts off bodily to give access to the plants as in the photo above, and the closed greenhouse is shown at left above

ALTHOUGH intended as a toy, this miniature greenhouse, which is built from scrap material, will prove interesting to grown-ups as well as children. It can hold a dozen or more tiny pots with growing plants, or two or three larger ones.

The greenhouse illustrated was made from store-box lumber and a number of old 4 by 5 in. photographic plates cleaned with hot water and an old razor blade. Of course, you can use scraps of window glass cut to size just as well.

The most suitable wood to use is cypress because it resists moisture, but almost any wood will do. The base is 1 by 7¾ by 13 in. A molded edge was cut to improve its appearance. Overall dimensions of the house, exclusive of base, are: width, 5¾ in.; length, 11 in.; height, measured to apex of roof, 7¾ in.

After shaping the base, cut corner pieces and other uprights as needed, and fasten them to the base with nails and glue. Space them so that the glass pieces will slide into ⅛ in. deep grooves. Run 3/16 by 3/16 in. strips around the base between the uprights to seal the lower edges of the glass. Connect the top ends of the uprights with similar strips, placed at one side so that the glass can be slipped into the grooves or removed.

The roof is separate, serving the purpose of a removable cover. In constructing it, first make a rectangular frame of ¼ by ½ in. material so that it will coincide with the top edge of the house proper Then construct triangular ends, the dimensions of which will depend on the width of the glass side panels used. The ridge piece is square in cross section and grooved on two adjacent surfaces. Spacers for separating the glass panels are grooved on the edges and measure about 3/16 in. or ¼ in. thick by ½ in. wide.

Fasten the wood frame together with casein glue and small nails or common pins used as nails. It is best to paint or lacquer all wood parts possible before assembling. The tiny earthenware pots can be obtained at almost any florist's. If desired, a metal tray can be placed on the bottom.—JOHN C. WORKLEY.

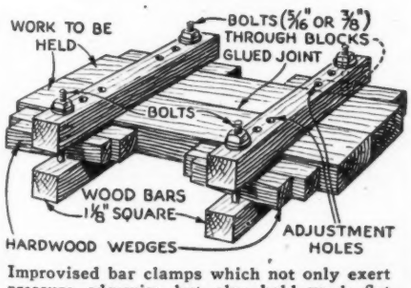
AUXILIARY BENCH AIDS THE MODEL MAKER

MY BENCH being pretty well taken up with lathe, emery wheel, saw, and other tools, I had to resort to what I call an auxiliary bench to gain working space. This is especially convenient for model making. It may be

Small auxiliary bench set up in the vise for light and delicate work

made of any stock about the shop; mine is a piece of ¾-in. pine, 8 in. wide and 24 in. long. Across one end a piece of ⅜-in. hardwood, 2 in. wide, is screwed to serve as stop for planing. On the other end a V-notch 3 in. wide and 4 in. long is cut to allow a coping saw or fret saw to be used. A block about 1½ by 2½ by 12 in. is screwed underneath and in the middle of the large piece to allow the auxiliary bench to be clamped in the vise at a comfortable height.—G. T. HOLMES.

HOMEMADE CLAMPS FOR GLUING WIDE BOARDS



Improvised bar clamps which not only exert pressure edgewise but also hold work flat

WHEN two or more boards have to be glued together to form a wide piece, it often happens that there are no cabinetmaker's bar clamps at hand, or too few clamps for the number of joints which have to be made at one time. The accompanying drawing shows a homemade clamp that is inexpensive and efficient. The dimensions given are satisfactory for bars up to 2 ft. in length; for longer clamps, both the bars and the bolts should be heavier. The bolts must be large enough to resist bending, and the wedges and blocks should always be slightly thinner than the material to be clamped. In use, the clamps should be slipped over the work, and the nuts drawn moderately tight; then the wedges should be driven in firmly.—HARRY N. ROWLAND.

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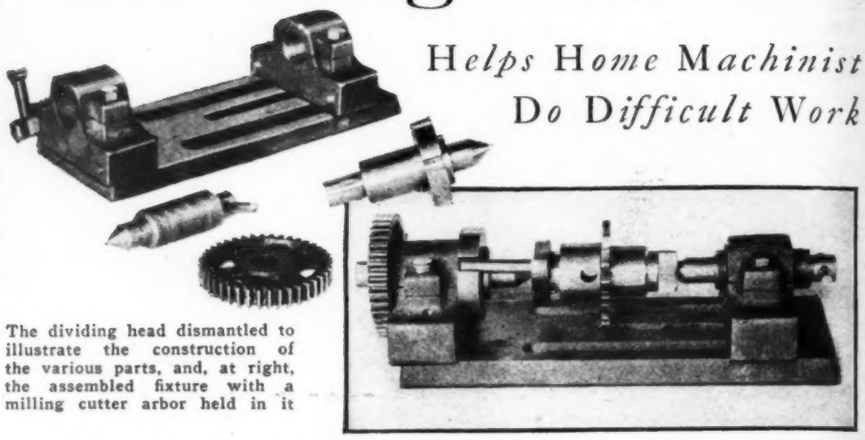
Helps Home Machinist Do Difficult Work



The dividing head dismantled to illustrate the construction of the various parts, and, at right, the assembled fixture with a milling cutter arbor held in it

MANY otherwise difficult or impossible operations in the home machine shop become comparatively easy when a small dividing fixture like that illustrated is available for use on the lathe, milling machine, or shaper. It can be used for spacing the flutes on reamers and taps, for cutting teeth in milling cutters, for cutting square and hexagonal ends, and also for making gears with a fly cutter.

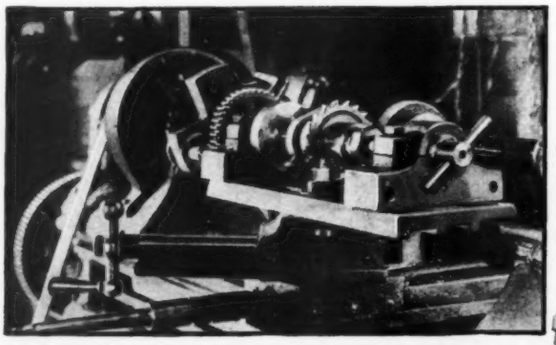
The device was constructed by B. L. Kemper, a druggist of Perham, Minn., who has for many years made a hobby of his home machine shop. He makes many of his own tools and has built much of his equipment, including both a milling machine and a shaper.

For obtaining the divisions for this indexing head, Mr. Kemper makes use of the screw cutting gears of his lathe. They give him every division from 2 to 16, then every even number up to 32, and also 36, 40, 44, 48, and 52, which is a sufficient variety for almost any amateur work.

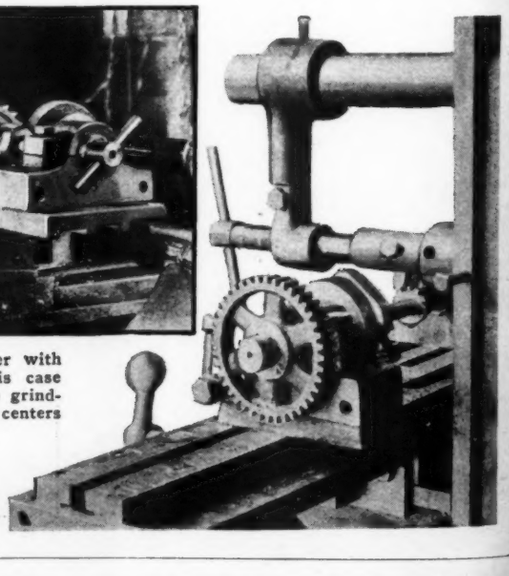
"The accompanying photographs," Mr. Kemper writes, "will explain the device well enough as the dimensions naturally depend upon the machines available. The base consists of three castings—the base plate and the two supports for the centers. The base plate could just as well be made from a piece of cold-rolled steel about ½ in. thick and 4 in. wide, which would eliminate the facing operations necessary in cast iron. The two center supports are made from the one pattern, and the tail center and its support are threaded for the easy removal of the work. Both supports are sawed through on one side so that a clamping screw will hold the centers absolutely tight. The centers, which are made rather heavy, will stand quite a tool thrust without springing. The center supports can be removed from the base and fastened directly to the table of my miller."

COLORING BRASS BLACK

A BLACK finish for brass can be obtained by a simple chemical process. Make a strong solution of nitrate of silver in one container and of nitrate of copper in another. Mix the two solutions together and dip the brass into it. Now heat the brass evenly until the required degree of dead blackness is obtained. This is the method often used by instrument makers.—L. H.



Grinding the teeth of a milling cutter with the aid of the dividing head. In this case the work is being done in a lathe, the grinding wheel being hung between the lathe centers



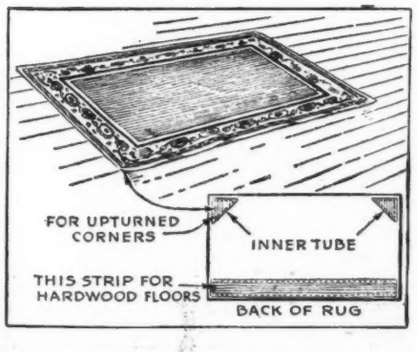
Another use is shown at the right—cutting teeth in a Woodruff type keyseat cutter by means of a fly cutter set up in a homemade milling machine

SHEET OF PAPER REMOVES DUST FROM AQUARIUM

When the sheet of newspaper is rolled back from the water, it carries the dust with it

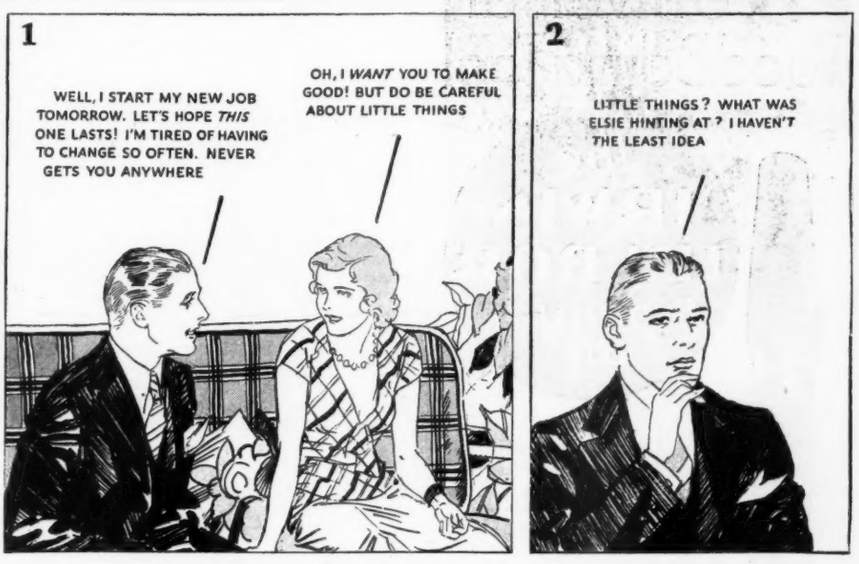
EVEN though an aquarium is covered with glass, a certain amount of dust will invariably accumulate on the surface of the water. The dust impairs the natural beauty of the aquarium and is detrimental to the fishes. To remove it quickly and easily, cut several sheets of newspaper approximately the size of the water surface and spread one of the sheets on the water. Let the paper remain until it begins to soak up the water—usually two or three seconds. Then take hold of one end of the sheet and remove it by lifting it upward and rolling it back. The dust will cling to the paper.—JOHN EDWIN HOGG.

OLD INNER TUBE STOPS RUGS FROM SLIDING



TRIPPING over a small rug which has upturned corners or falling because a rug slips on a polished hardward floor is a common household accident. It is easy to prevent such accidents, however, by applying commercial preparations to the back of the rug to prevent their slipping or curling up at the corners. Upturned corners also can be cured by sewing a small triangular piece of old automobile inner tube in each corner as shown; and a good way to prevent slipping is to sew a strip about 5 in. wide along the edges on the back of the rug. Have the inside of the inner tube facing outward so that it will be in contact with the floor. A rug so treated will not slide even when a vacuum cleaner is used.—JOHN DE VINK.

THE MAN WHO COULDN'T KEEP A JOB — by Timmins


1
WELL, I START MY NEW JOB TOMORROW. LET'S HOPE *THIS* ONE LASTS! I'M TIRED OF HAVING TO CHANGE SO OFTEN. NEVER GETS YOU ANYWHERE
OH, I *WANT* YOU TO MAKE GOOD! BUT DO BE CAREFUL ABOUT LITTLE THINGS
2
LITTLE THINGS? WHAT WAS ELSIE HINTING AT? I HAVEN'T THE LEAST IDEA

3
A MONTH LATER *he found out*
YOU SAY HE'S BRIGHT AND HARDWORKING, BUT CARELESS ABOUT "B.O." SURELY THAT'S A LITTLE THING
A MIGHTY IMPORTANT "LITTLE THING" IF YOU HAVE TO WORK NEAR HIM! ALL THE OTHERS ARE COMPLAINING. HE'LL HAVE TO REFORM—OR GO!
4
WHAT A FOOL I'VE BEEN! I'VE SEEN DOZENS OF "B.O." ADS, BUT NEVER DREAMED I COULD BE GUILTY. WELL, I KNOW NOW—AND I KNOW WHAT TO DO. I'LL GET SOME LIFEBUOY TODAY

5
NO "B.O." NOW
to spoil his chances
I'VE BEEN IN MY JOB SIX MONTHS, ELSIE. HAD A NICE PROMOTION, TOO. ISN'T IT TIME TO TALK ABOUT A WEDDING?
WHENEVER YOU SAY, DEAR

Don't let "B.O." (body odor) bar your way

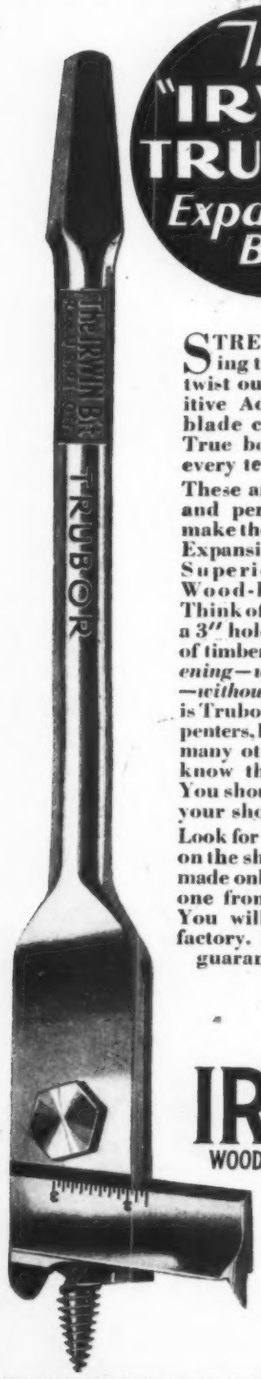
PORES are constantly giving off odor-causing waste. Play safe—bathe regularly with Lifebuoy. Its creamy, abundant lather *purifies* pores and removes all trace of "B.O." (*body odor*). Freshens dull complexions. Gets germs off hands—helps safeguard health. Its pleasant, hygienic scent vanishes as you rinse.

TRY LIFEBUOY FREE

If you don't use Lifebuoy and want to try it, send a clipping of this offer with your name and address to Lever Brothers Co., Dept. 6410, Cambridge, Mass. A full-sized cake will be sent you without cost.

(*This offer good in U.S. and Canada only.*)

The One Superior Universal Wood-Boring Tool



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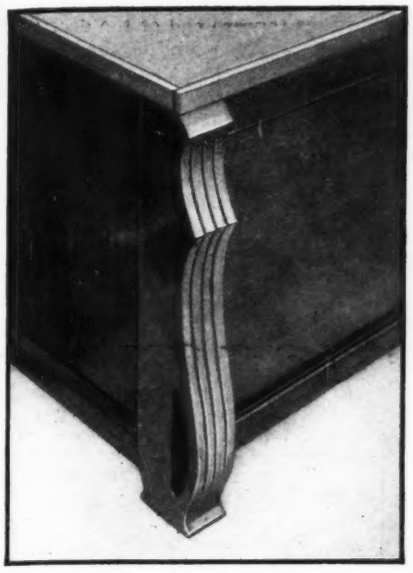
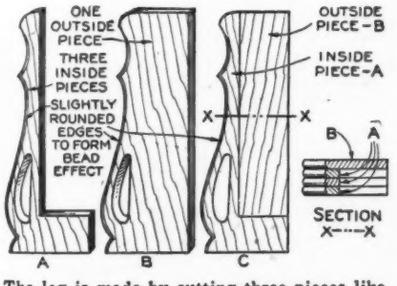
A SIMPLE WAY TO MAKE REEDED CHEST LEGS



A substantial chest leg built up from four pieces ½ in. thick to give a molded effect

AMATEUR woodworkers usually avoid any attempt at molding long, ornamental beads, reeds, or flutes on furniture parts unless they have a special plane or a routing machine suitable for the work. In many cases, however, a beaded effect can be obtained by building up the parts from several thin pieces. The chest leg illustrated, for example, was made of four pieces of ½ in. thick material sawed to shape, three being inside pieces as shown at *A* in the drawing, and one an outside piece like *B*. The pieces were lightly nailed together and the edges trued up and made exactly alike with a wood rasp and sandpaper. Then they were separated and the



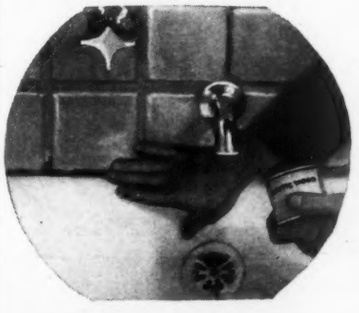
The leg is made by cutting three pieces like *A* and one like *B*, and assembling them as at *C*

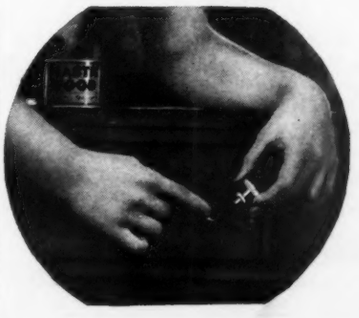
front edges rounded to give a beaded effect, as shown at *C*.

When finally glued and bradded together, these legs had the additional advantage of providing a strong support for the bottom of the chest and an unusually rigid corner construction. With a little ingenuity, this method may be adapted to many purposes.—CLINTON F. BLAKE.

EVERY owner of a small power shop is likely to have trouble with slipping belts. I have tried various commercial belt dressings, but have found nothing better than a stiff paste of powdered rosin in castor oil. It keeps the belts soft and pliable and makes them pull well.—B. L.

NOW LAUGH AT TROUBLE





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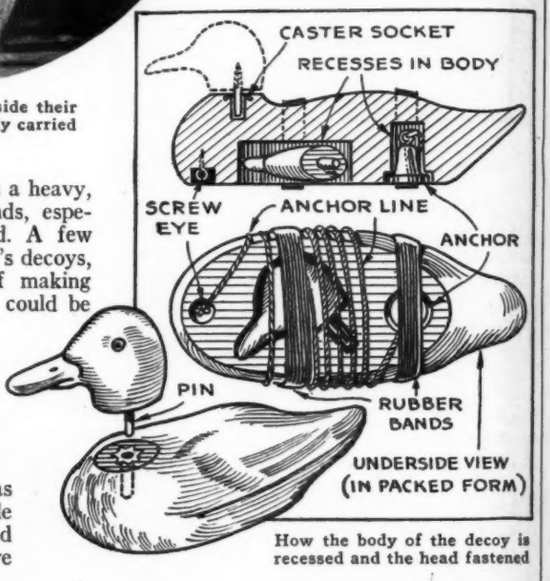
DECOY DUCK HEADS PACK INTO BODIES

With heads and anchors packed inside their bodies, the decoys can be more easily carried

WHEN hunting ducks, one has a heavy, bulky load to pack to the blinds, especially if many decoys are used. A few heads became loose on the writer's decoys, and this suggested the idea of making each head detachable so that it could be packed with the anchor in the body of the decoy.

A brass pin was threaded into the head in place of the dowel, and a caster socket fastened in the body. A hole slightly larger than the profile of the head and 1½ in. deep was centrally located in the underside of the decoy. Behind this a second hole was bored with an expansive bit to hold the anchor. At the forward end of the decoy, centrally located on the underside, a third hole was bored to contain the brass screw eye for fastening the line to the anchor. Small buttons of lead were added as necessary to balance the decoys. A ¾ in. wide rubber band cut from an old inner tube keeps the anchor in place, and the anchor line is wrapped around the body to prevent the head from falling out. To make still more sure that the head will not slip out, another rubber band like that used for the anchor may be applied.—C. ANTHONY VAN KAMMEN.

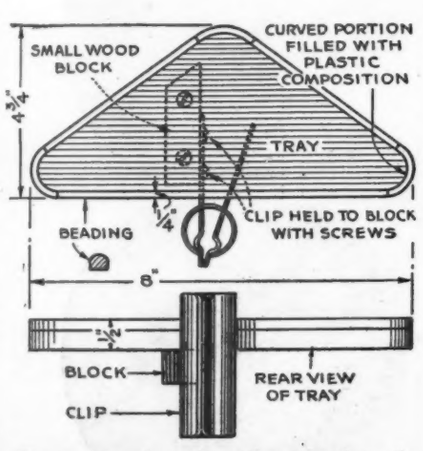


How the body of the decoy is recessed and the head fastened

TRAY CLAMPS ON LEG OF CARD TABLE

A NEAT little tray that holds two glasses and an ash receiver safely below the surface of a card table can be made from a piece of ⅜-in. pine cut in a triangular shape with rounded corners, as shown. A strip of wood beading should be glued along each of the straight edges, and the rounded corners filled in with a plastic wood composition, which is later shaped with a file to match the beading. A large size spring clamp, obtainable at a stationary store, is attached to a block underneath. It will hold the tray firmly on either round or square table legs.

A piece of felt or blotting paper is placed in the bottom of the tray to absorb liquids. A pair of these trays will help keep the top clear for playing.—E. E.

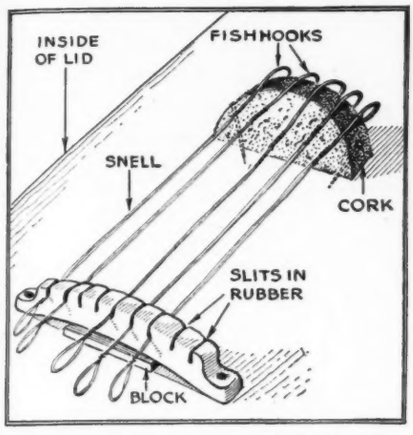


The tray consists of a triangular piece of ⅜-in. wood with a big spring clip attached

Small as it is, the removable tray has room for two glasses and an ordinary ash receiver

STORING SNELL HOOKS IN A TACKLE BOX

SNELL hooks can be stored in perfect order inside the lid of your fishing tackle box by means of the simple arrangement illustrated. Half of a large, flat cork about 2 in. in diameter is first nailed in an upright position to the inside of lid. This is for the points of the hooks. The snells are kept in place with a fastening

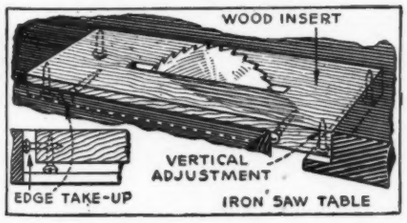


The fishhook points are set into the cork, and the snells are slipped into the slits

which resembles a violin bridge to some extent, but is cut from soft rubber (a piece of an old eraser will do). This is 2 in. long and about ⅜ in. square and has deep slits cut across its upper edge. It is attached to the lid with nails and is blocked up in center so slits remain open.

To place a hook, push the point into the cork and pull the snell taut, inserting it in a slit directly opposite the hook. Snells cannot get tangled if properly arranged, and they will dry straight.—P. B. PRICE.

ADJUSTABLE INSERT FOR SMALL SAW TABLE



Six oval-headed screws placed as shown make it possible to adjust the insert accurately

THE wood insert in the center of the iron table of a small circular saw will shrink in winter and swell in summer, especially if the machine is in a basement shop that is relatively damp at times. Sometimes it may have to be hammered out; at other times it will be loose and not quite flush with the top of the table. Such an insert, however, can be kept snug. Take it out when it is tight and rip ⅛ in. from one side; then drive two ½-in. No. 4 oval-headed screws in the cut edge about 1 in. from the ends. These screws can be adjusted in and out as necessary. Similarly, about 1/16 in. can be planed off the bottom and four screws used for the vertical adjustment.—C. W. OLSON.

Now 2 New Jig Saws by "Driver"

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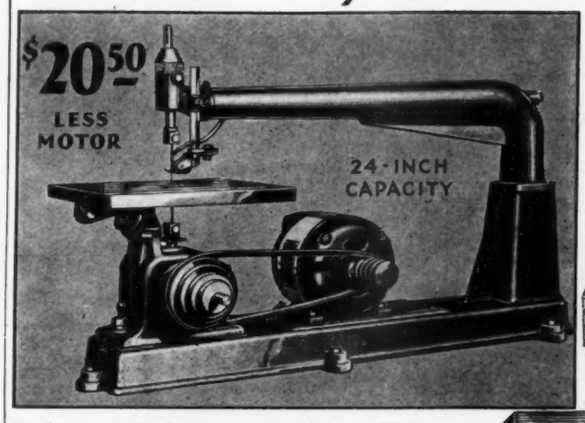
For business or hobby—as money-makers or means of diversion—these new DRIVER Jig Saws are unequalled! Every step in development was taken with infinite care—with one ideal in mind—to produce a *better* jig saw. Every step in manufacture is made with the same exacting diligence—to see that ideal realized in the finished tool. Call at your local DRIVER store and inspect the new models—there's no obligation.



Sabre Sawing—Sanding—Filing

Every feature of these superb machines will appeal to the man who admires quality tools. The ingenious grooved roller guide, the spring hold-down, heavy cast iron tilting table, universal vises which hold all sizes of blades and permit operation from the sides as well as the front, the selective four speeds, the ability to operate with the arm removed thereby obtaining unlimited capacity, and many other advantages available only in DRIVER Jig Saws are your assurance of a "thrifty" investment. Add to these features the ability to do efficient sabre sawing, filing and sanding without additional parts (excepting the necessary accessories) and you'll realize why these machines represent the greatest tool values ever known and why other jig saws will appear obsolete by comparison.

Go to your nearest "DRIVER" store today and see a new Driver Jig Saw in action. If the dealer has not been able to get delivery yet, send us the coupon for descriptive literature.

WALKER-TURNER CO., Inc.
PLAINFIELD, N. J.

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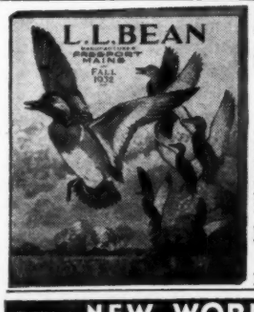

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We can supply construction sets and all sorts of parts such as semi-finished hulls, blocks, deadeyes, special flags, anchors, steering wheels, capstans, figureheads, blue prints, books, etc., for building real fine scale models of the Destroyer Preston, Whale Ship Wanderer, Flying Cloud, Constitution, Spanish Galleon, Mississippi River Steamboat, Sovereign of the Seas, Bluenose, Mayflower and many others. Also special construction sets for racing sail boats, power boats, model steam engines, propellers, etc., and fine tools for the model maker. Our large 64-page photographically illustrated booklet contains valuable information and hints for building ship models in addition to prices and full description of the above articles. Many people only slightly interested in models have become greatly enthused upon receiving this booklet. A copy will be sent postpaid upon receipt of 15cts. (coin preferred).

Model Ship Supply Co., Dept. R, Mineola, N. Y.

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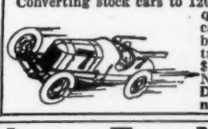
Automobile Racing—NEW BOOK



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New and Better Machines For Your Shop

New machines, improved models, new useful attachments constantly being added to the Boice-Crane Line. Make your workshop efficient, practical, and up-to-the-minute with these highly perfected machines. Experienced woodworkers prefer them for their capacity, accuracy, ruggedness, and low cost.

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One year of splendid performance is now behind this popular Boice-Crane Machine. Made with two sizes of table 15"x17½" and 20"x27½". Bronze or ball bearings. Cuts 2½" thick with 9" saw. Mortising Attachment has ½" square capacity.

SPINDLE SANDER

The latest Boice-Crane Machine. Sands edges of straight or curved work. Oscillates ½". Rotates 3000 r.p.m. on ball bearings. Table 20"x20". Uses sleeves 3", 2", 1" dia. x9" high. Endless abrasive sleeves and rubber drums give wonderfully smooth finish. Driven by ¼ to ½ h.p. motor and V belt.

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Large 52-page Workshop Catalog sent upon receipt of 10c in stamps or coin (which only partly pays mailing cost). Gives complete information on saws, lathes, jointers, jig saws, band saws, shapers, sanders, motors, and workshops.

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Money can't buy better. Swing 11". Centers 42" and 60". Four speeds. New ball bearing back rest makes turning of long spindles easy. Also other lathes for wood or soft metal.

12" — 14" BAND SAWS

Two popular Boice-Crane Band Saws that have given years of faithful service. Tables tilt 45°. Especially valuable for boats, furniture, novelty, and pattern work.

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TUNNEL GOLF—A NEW BLIND-TRAP GAME

When bolted together with the strips interlocking, the two disks form a maze

The maze as made by the author. The black dots indicate dowels which block the tunnels

TUNNEL golf is a new, novel pastime for fall and winter entertainment. To make it, three 10-in. disks of three-ply veneer are used, with a steel ball bearing to serve as the "golf" ball.

Place one of the disks on the scroll saw and cut it up into a spiral strip about ¼ in. wide, as illustrated. Cut this up into various lengths and glue part of it to another disk to make a "magic maze" with channels or tunnels through which the ball bearing can roll easily. The passages, however, must be obstructed in places with "traps" as shown; these stops are merely short pieces of doweling glued firmly. Part of the remaining spiral strips are then affixed to the remaining disk in such a way that they will mesh or interlock properly when the disks are placed together.

A hole is made for entrance of the ball bearing near the center of one disk, and a gap or opening in the outermost spiral strip provides an exit at the edge. The prepared disks are then fastened together with a central bolt.

The player holds the round game board thus made and drops the bearing into the hole near the center. From there on the "golfing" is "blind" and must be completed by a sense of balance and feeling. If the ball can be maneuvered so as to miss the traps, it will make an exit at the side. When a player becomes accustomed to the arrangement, revolve the top disk sufficiently to change the relation of the "traps." Prizes can be given for winning in the shortest time.—KENNETH MURRAY.

Cutting the spiral strip on a scroll saw

WOODEN CASTER WELL HOLDS STEEL WOOL

A WOODEN caster well of the type illustrated at the left makes an unusually good holder for steel wool, especially when polishing metal or when a coarse grade of steel wool is being used. Larger areas of the wool are presented to the work than when the steel fibers are held in the fingers, and steel splinters cannot enter the skin.—R. W.

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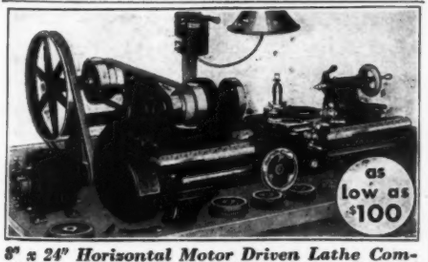
Mended Cracks & Holes in Plaster Walls & Ceilings

He wrote us as follows, "Your Patching Plaster is a mighty Godsend to the small house owner who cannot afford to call in a plasterer, and who still desires to keep his house in good repair." . . . Anyone can use Rutland Patching Plaster and make permanent, satisfactory repairs. Nothing runs down property faster than bad-looking cracks and holes in walls and ceilings. Our other product, Rutland Concrete Patcher, mends portland cement and concrete. Each comes in a handy package and each contains correct ingredients ready-mixed. Just add a little water and apply. Get whichever one you need at your paint, wallpaper or hardware store today.

Made by the Rutland Fire Clay Co., Rutland, Vermont.



8" x 24" Horizontal Motor Driven Lathe Complete as shown. Weight 240 lbs. **$132.25**

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With six spindle speeds—hollow spindle—cuts screw threads 4 to 40 per inch—automatic screw feed to carriage—bed lengths 24" to 48"—countershaft and motor drive, bench and floor leg models price range $100 to $217—convenient terms.

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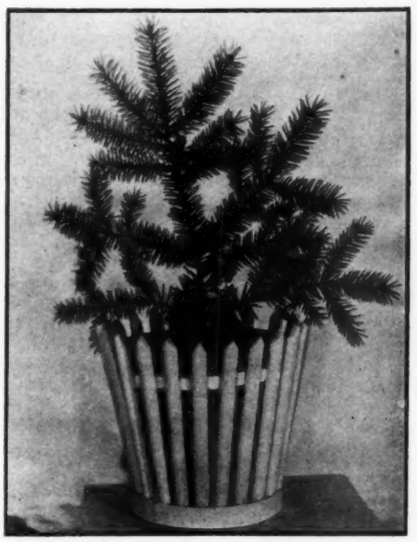
Factory Rebuilt Lathes—at bargain prices. Only a few available—write for list.

SOUTH BEND LATHE WORKS
827 E. Madison St., South Bend, Ind.

SMALL PICKET FENCE HIDES FLOWERPOT

A MINIATURE picket fence to cover and partly conceal an unsightly clay flowerpot can be made as shown from about twenty-four pieces of ½-in. half-round wood molding or beading, each approximately 6 in. long.

Whittle one end of each piece to a point and sandpaper it thoroughly. Cut a ½ in. wide rubber band from an old inner tube and fasten the strips to it with ½-in. tacks, clinched against a piece of metal. No spaces should be left between the strips, as they will spread apart when the band is stretched over the flowerpot. The circular cover of an old can may be used as the base.

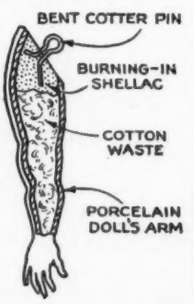


Neatly painted pickets held at the top by a rubber band form this novel flowerpot holder

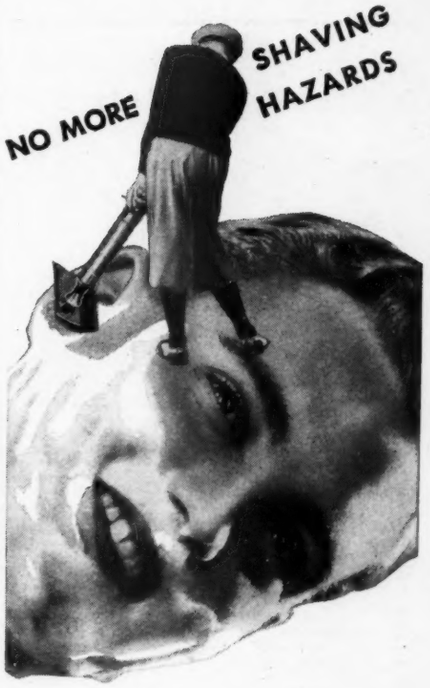
It is best to paint the pickets, rubber, rail, and base some bright color before putting the parts together. Then slip the assembled fence over the flowerpot from the bottom and tuck the lower ends of the pickets inside the rim of the can cover which forms the base.—E. T.

REPLACING EYELETS IN A PORCELAIN DOLL

WHEN an eyelet breaks out of one of the porcelain arms or legs of a doll, fill the hollow part of the arm or leg with soft cotton waste to within ½ or ¾ in. of the top and then insert a cotter pin through the hole, as illustrated. Melt a small amount of stick shellac of the kind used in concealing blemishes in furniture and pour it around the cotter pin until the opening is full, or use sealing wax, rosin, or the composition with which dry cells are sealed. The cotter pin should be set perpendicular to the joint surface of the arm or leg.—GLENN W. HARDING.



Cross section view of a repaired arm



Soak whiskers soft in this soothing extra-moist lather

. . . for quicker, smoother shaves

MEN—with this new, extra-moist lather, you can now get the slickest, quickest, easiest shave ever. For it softens tough beards in a hurry—soothes and protects tender skin.

52% more moisture

You can't get a good shave with light, fluffy lathers—they dry too quickly. But, as laboratory tests show, Lifebuoy Shaving Cream lather will hold *52% more moisture* than ordinary lathers. It keeps your whiskers soaking from start to finish—thoroughly softens them up for your razor. You get a smoother, closer shave in half the time—without pull, slice or stinging razor-nicks.

Try it—for your next shave

Don't be stymied by a tough beard. Lather with Lifebuoy. You'll hardly feel the razor as it skims through your lather-softened whiskers. You'll break all records for fast, clean, feather-light shaves. And your face will feel like a million dollars—cool, soothed and refreshed.

Get the big red tube of Lifebuoy Shaving Cream at your druggist's today. Or write for a free trial tube to Lever Brothers Co., Dept. H10, Cambridge, Mass.

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EXPERIMENTS WITH GAS FOR HOME LABORATORY

(Continued from page 55)

solubility. It is by this means that salt is extracted from sea water. Large ponds of sea water are allowed to evaporate and as the solution becomes more and more concentrated the salt crystallizes out while the more soluble substances remain behind.

Some chemicals exhibit curious color changes when made into solution. Copper bromide crystals shaken with a very small amount of water produce a reddish brown liquid. Adding a very small amount of water makes a green solution. If still further diluted, the liquid will become blue.

Cobalt chloride or cobalt nitrate dissolved in water and applied to a white cloth will color the cloth blue or red, depending on the amount of moisture present in the surrounding atmosphere. The little "weather forecasters" in the form of flowers or dresses on cardboard figures are made of cobalt-chloride treated cloth. When there is little moisture in the air, the crystals of cobalt on the cloth remain blue. When the humidity increases, the cloth becomes red or pink. You will have no trouble in making these moisture indicators in your home laboratory from cloth and cobalt chloride.

SANDING SHARP CURVES ON POWER JIG SAW

THOSE who have used disk and drum sanders and have learned how much labor they save will appreciate a method for sanding small, sharp curves and inside cuts that cannot be reached by these tools. The idea is simply to utilize the power scroll saw or jig saw for this work by making sanding blades of various sizes and degrees of fineness. This is done by gluing sandpaper to a metal backing. The metal may be any old scrap, or a piece may be cut from a tin can. The metal blank is made the same length as a fret saw blade; and if from an old can, the outside of the tin should be coated with shellac to make the glue take.

Both sides of this blank are coated with glue. A piece of sandpaper or cloth of the desired grade is then placed against the glue, and the whole set between two hardwood blocks and clamped in the vise overnight. Then strips are cut from the blank with the tin snips, varying in width from ⅛ to ⅜ in. These strips, which must have both ends cut to enter the slot provided for the fret saw blade, are used as required.

As the blades are so easily and cheaply made, a good supply of various grades may be kept on hand. Ordinary sandpaper may be used, but the cloth wears longer. Emery cloth, however, is not suitable for use on wood.—H. CALDWELL.

COMPRESSION GAGE COCK IMPROVES BLOWTORCH

IF THE needle valve on many ordinary types of blowtorches is left closed after use, the contraction of the metal around the hole against the needle valve may enlarge the hole and ultimately make the torch useless. Of course, the needle valve may be left open and the pressure let out of the tank by unscrewing the pump, but a better plan is to thread a compression gage cock into the top of the tank under the rear end of the burner. A cock of the needle variety must be used; any other kind will leak. As the thickness of the tank metal is too thin to support the cock properly, a ridge of solder should be built up around the base of the cock.

When through using the torch, extinguish the burner, reopen the valve, and then open the compression cock.—A. L. EVANS.

CROSLEY *Electric* REFRIGERATOR
Latest Features... Full Family Size

Now Within the Reach of All

A FULL size 3½ cubic ft. net capacity electric refrigerator bearing a nationally known and recognized name at a phenomenally low price. Not a midget. Incorporates all latest features—self contained and removable unit, temperature control for quick freezing, defrosting switch, flat bar shelves, perfect insulation, flat top, broom high legs, white porcelain interior, plenty of ice cubes. Also two other sizes: 4½ cu. ft. net capacity, $99.50; 5½ cu. ft. net capacity, $139.50. All prices F. O. B. factories, tax extra. Send for Booklet or see nearest Crosley dealer.

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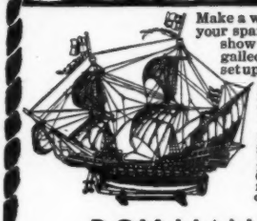
THE CROSLEY RADIO CORPORATION
Dept. E-91 Cincinnati, Ohio

BUILD "GOLDEN HIND"



Make a worthwhile 32½" model in your spare hours. Clear drawings show the true line of Drake's galleon of 1577. Also how to set up masts, rigging, line, sails, and flags. Hull comes fully shaped and sanded, with forecastle and deck in place. Outfit includes guns, channels, lantern, all fitting, even paint and brushes for decorating. Complete set for only $9.75 plus 6 lbs. post. Send 15c (coin) for interesting catalog of other models.

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in assorted color cases
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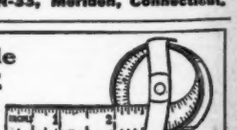

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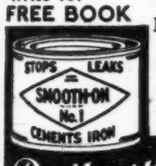

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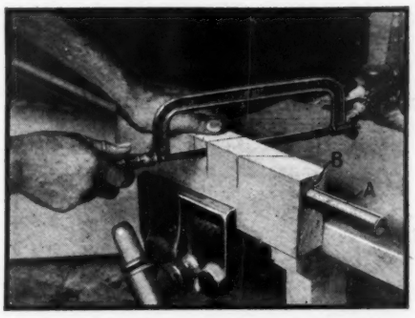
GUIDE FOR ANGULAR CUTS IN CYLINDRICAL STOCK



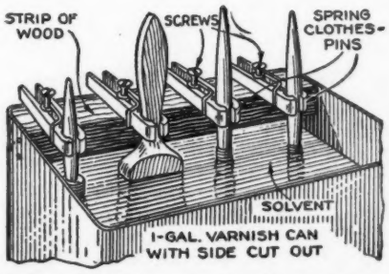
How to hold tubing, dowels, and other cylindrical stock which must be cut at an angle

IT IS difficult to saw off several pieces of brass or steel tubing, or even broomsticks, dowels, or other wooden cylinders, at a given angle and have all cuts exactly alike. A good way to accomplish this is to make a sort of miter box from a piece of hard wood an inch or more thicker than the outside diameter of the cylinder to be cut and wide enough to be held firmly in the vise. Bore a hole through the block large enough to allow the cylinder to be pushed through easily, but not too loosely. Make a cut or cuts in the block at the required angle or angles.

As there is always a tendency for the stock to turn while being sawed, it is well to scribe a line the entire length of the top of the cylinder as at *A* and make a corresponding mark on the block at *B*. If care is taken to see that line *A* on the cylinder and line *B* on the block coincide at all times, the cuts will be uniform and will match each other accurately.—A.K.C.

HANGING PAINTBRUSHES IN CAN OF SOLVENT

AMATEUR painters frequently find it a problem to keep their brushes soft. My plan is to cut out one side of a 1-gal. varnish can and put a strip of wood along one of the top edges as shown. To this strip I fasten several spring type wooden clothespins by passing a screw through



Spring clothespins make it easy to support the brushes so that the bristles are covered

the spring of each. A quantity of whatever solvent is to be used is then poured into the can, and the brushes, whatever their length, are suspended from the clothespins so that the bristles will be covered by the solvent yet will not touch the bottom or sides of the can. An improvement would be a cover to go over the entire can as a protection against dust.—KENNETH BARNES.

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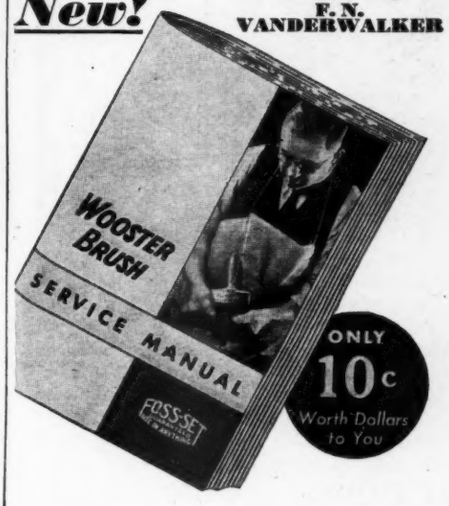

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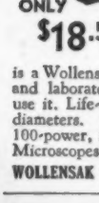

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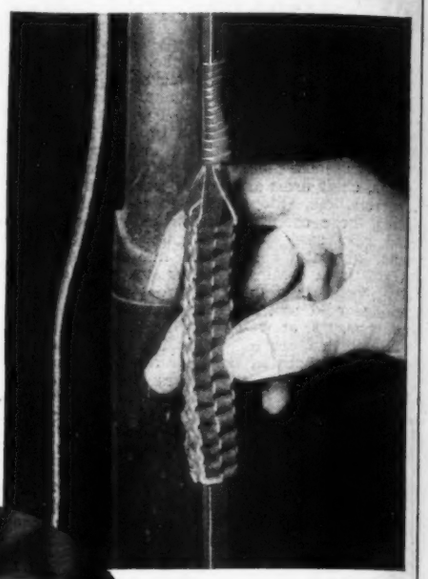
BRAIDING FLEXIBLE LEATHER HANDLES

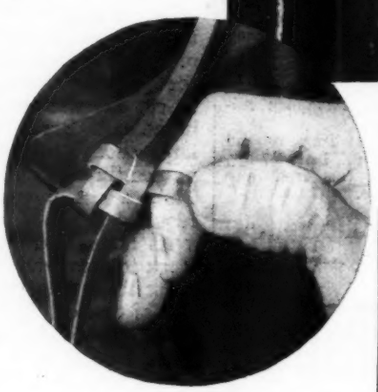
UNUSUAL handles suitable for a variety of uses can be made from leather thongs. The illustrations show the construction of a braided switch pull for use on a floor lamp that was made from an ancient musket. The leather matches the lamp perfectly.

Obtain some calfskin or similar leather in sheet form, and cut strips about ¼ in. wide. The length will depend on the size of the handle, but pieces can be spliced if necessary by beveling the ends and fastening with a good leather glue.

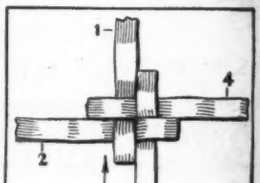
Arrange four thongs so that they are at right angles to each other and cross at a point 2 in. from one end of each piece. Each thong, in this position, will cross two others—over one and under the other as shown clearly in the photo below and in the accompanying diagram. Now bring the short ends together and clamp them in a vise, or tack them to the workbench, and proceed to braid the handle in the manner illustrated. In bringing over the first thong to start each round, leave a loop through which the end of the last thong can be passed. Draw all pieces tight before proceeding with the next round.



This decorative switch pull with its braided leather handle is used on a floor lamp made from a musket



The braiding process is illustrated above, while the diagram shows the arrangement of thongs at the start



Leather comes with only one surface finished. If the thongs are laid with the finished sides up at the start, the completed handle will have, on each of its four surfaces, a strip of finished leather paralleling a strip of unfinished. This arrangement can be varied by turning two of the strips over at the start. The design can be modified further by using different colored thongs in any way desired.

The completed handle will not unravel unless the ends are trimmed close. In that case, apply a little adhesive. The method of attaching the handle to a cord or other object will depend largely on the object.

Leather is not the only material that can be braided in the manner described. Heavy cord, rope, flexible wire, and the like can be used.—VERNON B. CASE.

FEATHERED CORNCOB DARTS USED IN TARGET GAME

DARTS made from long straight corncobs with four turkey or chicken wing feathers inserted in the butt end of the cob as shown may be used in an outdoor target game for boys. Place the back of each feather toward the center of the cob in order to give the dart a spinning movement when hurled through the air. This will help a good deal to insure accuracy and higher scores.

A dart and the method of throwing it

Each player tries to place a dart as close as possible to a stake driven in the ground at a suitable distance away from the line on which the contestants stand. If preferred, a bull's-eye may be marked on the ground and scoring rings used, but there should be a stake in the center to aim at. This is the arrangement shown in the drawing above.—GEORGE A. SMITH.

HOW TO WATERPROOF MATCH HEADS

MATCHES to be used while camping can be made entirely waterproof, and they will also hold a large flame when lighted in the wind, if the heads are first dipped in a celluloid solution and allowed to dry. The solution is made by dissolving celluloid scraps in acetone.—G. S. G.

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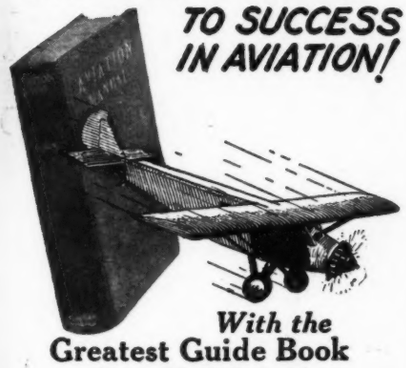

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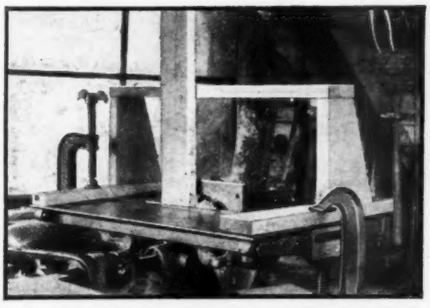
TENON CUTTING GUIDE FOR CIRCULAR SAW

ACCURATE tenons can be cut on a small circular saw with the help of the auxiliary fence shown in the accompanying illustration. This device is made of 1-in. stock fastened throughout with screws. It may be built to fit whatever saw it is to be used with, but in any event the elevated cross member should be at least 10 or 12 in. above the saw table.

Before the auxiliary fence is put in place, the regular fence on the saw table is set properly to cut a tenon of the desired width. It is possible to do this so that first one side of the tenon may be cut and then, by reversing the stock, the other side, without change of fence adjustment. The saw table is, of course, set to cut the right depth—in this case, the length of the tenon.



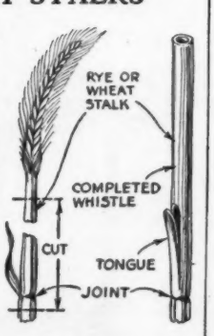
This quickly made auxiliary fence helps in cutting tenons accurately on a circular saw

To function properly as a guide to the stock being cut, the inner edge of the upper cross member of the auxiliary fence must be in the same perpendicular plane as the inner face of the regular fence on the saw table. This may be insured by using a carpenter's steel square with one edge on the saw table and the other edge against the inside face of the regular fence, extending upward. The square should be used first at one end of the fence and then at the other, and the edge of the auxiliary fence must touch the square at both points.

When properly aligned, the device is held with C-clamps and the tenon cuts may then be made. The operator must be careful to hold the stock snugly against the auxiliary fence as it passes through the saw.—A. V. COMINGS.

NOISE-MAKERS FROM RYE AND WHEAT STALKS

MANY boys have never learned the old trick of making a sort of whistle from a stalk of rye or wheat. Simply pull off the leaf around the upper joint of the stalk and cut the stalk as indicated. Then use a sharp penknife to cut a narrow tongue close to the joint end. This curious little instrument is blown by placing the lower end—that with the vibrating tongue—in one's mouth.—G. S.



The EXPERT WAY to SHARPEN A CHISEL

HOLD your chisel as shown, and take even, smooth strokes until a "butt" or wire edge is created. Do this on the coarse-grit side of The Carborundum Brand Stone.

Now, turn the stone over, flatten out the angle at which your chisel meets it, and take just a few light strokes on the fine side of the stone.

To remove the wire edge, return now to first angle of holding your chisel and take a light stroke or two, still on fine-grit side of stone—and—

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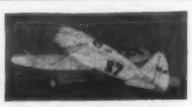

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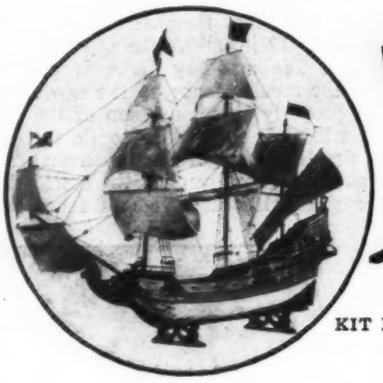

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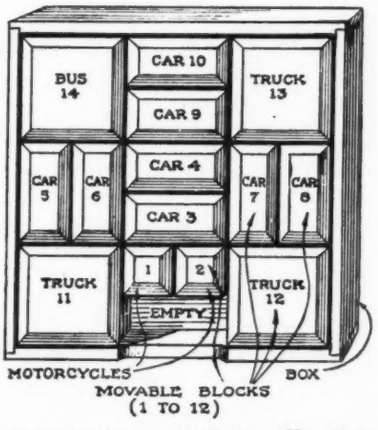
CAN YOU SHOW GUS AND JOE HOW TO SOLVE THIS PUZZLE?

HERE is a plan of the Model Garage after Gus and Joe have put in a particularly strenuous day. They are at home relaxing, but as usual they have left the garage all spick and span, cars packed in closely, and locked up for the night.

But trouble is on its way! The bus driver has received a hurry call to get his bus out and go to the railroad station for some stranded travelers. Of course, his bus *would* be right at the back of the garage. Can you help Gus and Joe in this emergency to move the bus over to the doorway, ready to run right out?



The problem is to move the bus (No. 14) to the "doorway" simply by shifting the blocks

You can do it without taking any cars out of the garage and without turning a single one.

The puzzle is worked with fourteen pieces cut from wood or cardboard; they may be of any convenient size providing the proportions are as shown. Thin wood blocks are easier to shift around than cardboard, and they may be left plain or finished neatly with beveled edges. Give each block its identifying name and number. Then prepare a shallow box or tray to hold the puzzle.

The object is to move the bus (block No. 14) to the garage door—the space now partly occupied by motorcycles Nos. 1 and 2—without removing any block from the tray. The blocks must not be turned. For example, car No. 6 cannot be turned to a position like that of car No. 3.

For those who wish to check their solution with that originally made by the writer, the sixty-three moves are as follows, L meaning move to left, R to right, D down, and U up: 1D, 1 R, 11 R, 5 D, 6 L, 3 L, 4 L, 2 U, 1 U, 11 R, 5 R, 6 D, 3 L, 4 L, 1 L, 1 U, 3 R, 4 D, 14 D, 10 L, 9 U, 1 U, 2 U, 3 U, 4 R, 14 D, 10 D, 9 L, 2 U, 2 L, 13 L, 8 U, 7 R, 3 R, 4 R, 1 D, 2 D, 13 L, 8 L, 7 U, 3 R, 4 R, 1 R, 2 R, 14 R, 6 U, 5 L, 11 L, 1 D, 2 D, 14 R, 6 R, 5 U, 11 L, 2 L, 2 D, 14 D, 3 L, 4 U, 12 U, 1 R, 2 R, 14 D.

After many attempts to better this record, a shorter solution in fifty-nine moves was discovered. Perhaps you can find that one, too. Here is a hint: do not move truck No. 13 at all.—ERIC B. ROBERTS.

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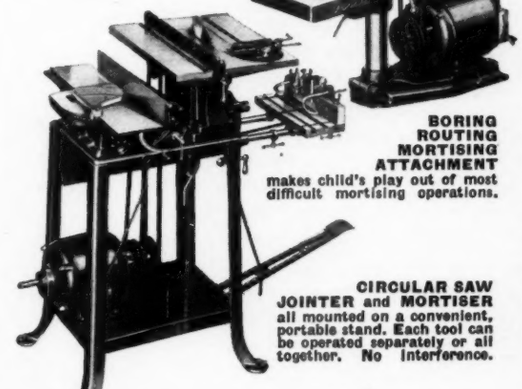

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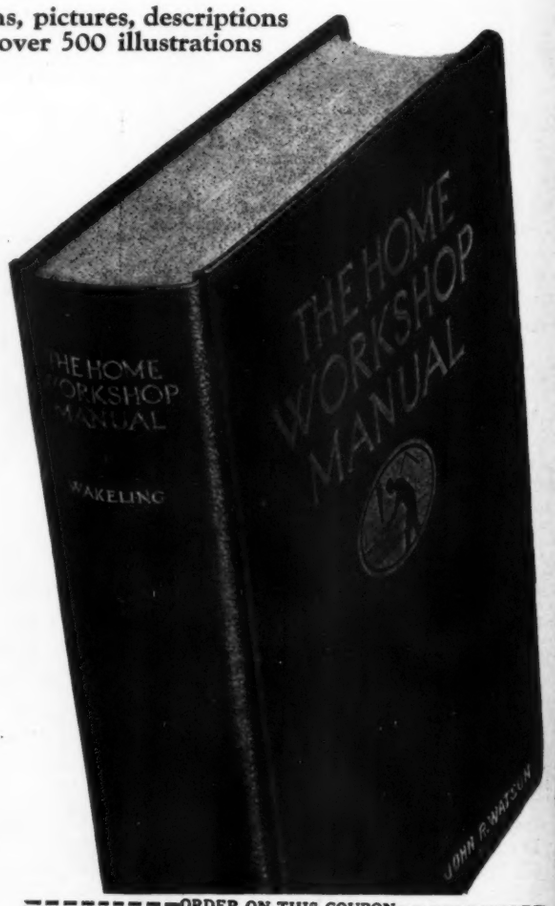

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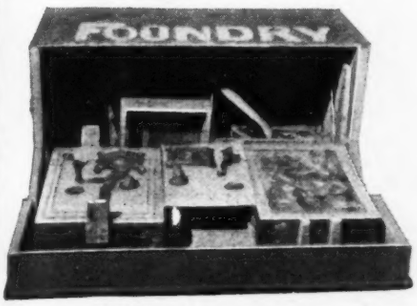
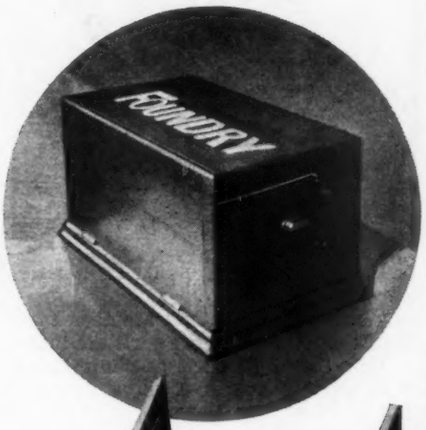
Casting Small Metal Parts

IN THE HOME WORKSHOP



The kit ready for use with mold open. Four small patterns are lying on the board in center



PART ONE—The Foundry Box

By *Joseph C. Gilbert*

How equipment is packed and, above, the foundry box closed up

SMALL castings of lead, type metal, aluminum, and various nonferrous alloys, including even brass and bronze, can easily be made at low cost in the home workshop with a small casting outfit such as that illustrated.

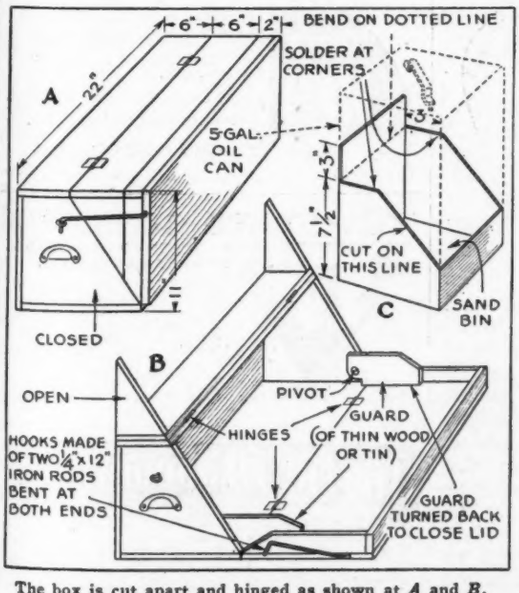
Many broken mechanical parts can be duplicated and replaced simply by using the broken pieces, temporarily glued together, as a pattern for molding. The model maker, too, may make real castings instead of using imitations for the metal parts of his models, and the experimenter and inventor can cast and recast until perfection is attained. All the equipment required for an outfit suitable for this work does not cost two dollars, and any handy man can make the kit.

One of the accompanying photographs shows the home foundry box closed; another shows it open with all the equipment and tools inside; the third shows a complete mold opened and with four small patterns on the board resting between the cope and drag; and the fourth, on the following page, shows the flask on the lid in position for molding.

Among the parts the author has cast with this equipment are the fittings for several Spanish galleons and other ship models, an aluminum handle for a carving knife, a crank shaft, a 9-in. propeller blade, and small anchors and cannons.

The box is so designed as to keep everything needed within one unit that can be moved and stored anywhere. It also prevents the loss of sand caused by spilling it on the bench and tracking it over the floor.

A ready-made box is used, but it is altered as shown in the drawing. The over-all size is 11 by 14 by 22 in., and the stock is 1 in. thick throughout. The back and top, however, could be thinner; in fact, ½-in. stock would be heavy enough for them. First the box is nailed all around excepting along the lower front corner where the hinges are to be fitted for the lid. When this has been done, line off the ends and top



The box is cut apart and hinged as shown at *A* and *B*, and the tin sand bin made from an old oil can as at *C*

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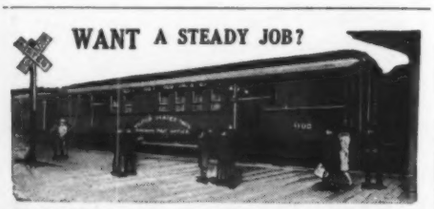

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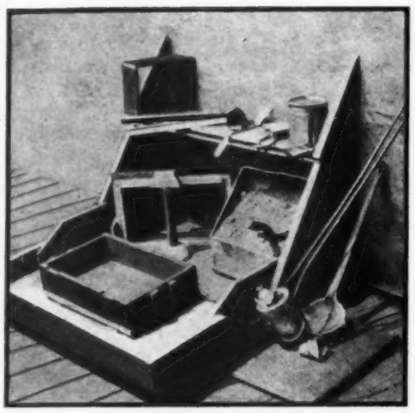


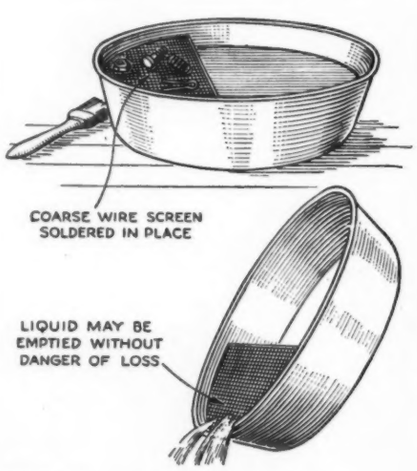
Another view of the kit which shows where the flask is placed on the lid for molding

as indicated at *A*. Cuts are then made along these lines, and the parts are hinged so that they will open as shown at *B*. Note the two guards or filling pieces of thin wood or tin; they are turned back before the lid is closed.

The bin for the sand is made from a 5-gal. oil can by cutting it as suggested at *C*. The 3 in. wide flap at the back is bent forward and soldered at each side where it meets the ends. It is best to paint the inside of the bin to prevent the tin from rusting.

In two articles to follow, Mr. Gilbert, who has had thirty-three years of practical experience in foundry practice, will explain what foundry equipment is required in a home workshop outfit and tell exactly how to make small castings.

A SCREENED WASH PAN FOR SMALL PARTS



WHEREVER a large number of small machine screws and parts have to be washed in gasoline to remove grease and grime, as in garages and repair shops, valuable pieces are often lost or overlooked and thrown away with the used gasoline. To avoid this, a repair shop mechanic soldered a section of heavy screen wire over part of the top of the wash pan as illustrated above. Small parts can be placed on the screen for washing with a brush. The same screen also serves to salvage any parts accidentally left in the pan.—G. E. HENDRICKSON.

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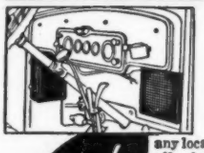

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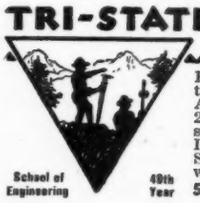

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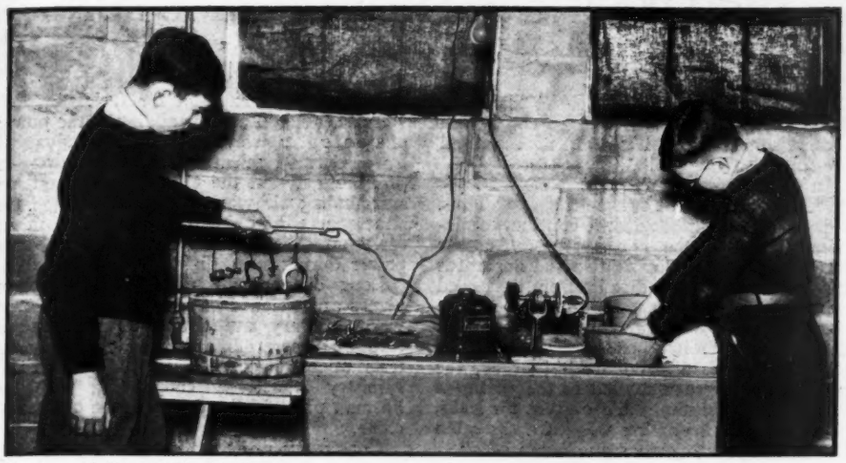

Courtesy of General Electric Company

Two energetic boys can earn extra pocket money by doing nickel plating for neighbors

Small Battery Charger

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Nickel Plating

By R. H. ROGERS

ANY boy who has a battery charger of the "tungar" type in his home can do practical nickel plating for fun or profit. Experimenters, too, should be interested in this electrochemical process, especially as it employs a vacuum tube. The work turned out is of standard commercial quality.

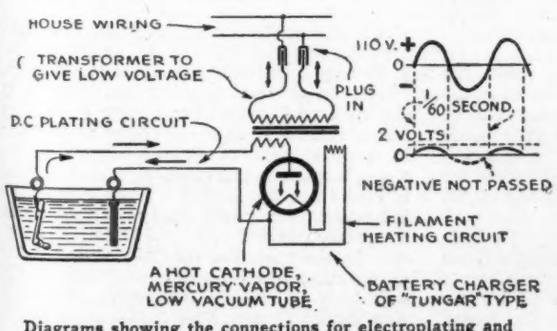
To do nickel plating one must have a source of low voltage, direct current electric power, a tub or jar, and some nickel salts and nickel castings, called "anodes," which can be obtained from dealers in electroplating supplies. The battery charger furnishes the direct current at the proper voltage from the alternating current house circuit. An old battery box, a sawed-off wooden ice cream tub, or an earthenware crock will serve for the electrolytic cell.

Make up the solution according to the instructions which accompany the salts and put it in the cell. Lay two rods across the top (old brass curtain rods are satisfactory) and hang the anodes on one and the objects to be plated on the other. Suspend the articles on copper wires and see that the solution covers them. Connect the positive (+) lead from the 2/4-volt tap on the battery charger to the anode rod, and the negative (—) lead to the other rod, and turn on the current.

In a period of from one quarter to half an hour or less, depending upon the voltage used and the surface area of the particles, a fine hard coating of nickel will be found securely plated on the work. A heavy, long-wearing coating is white or gray-white and dull, therefore a small motor and cloth buffing wheel are needed for giving the objects a high polish. Thinner plating—that put on in a shorter time—has a good gloss without buffing, provided the work was originally smooth.

Articles to be plated should be thoroughly scrubbed with a strong washing powder and well rinsed. The test is to see if water adheres to the whole surface; if it does, the solution will make a good contact and a satisfactory plating job will result. The rods should be rubbed occasionally with sandpaper to insure a perfect contact. No two articles should touch each other in the solution, nor should they touch the anodes.

There are many things about the home that can be improved in appearance and made tarnish-proof through nickel plating—radio parts, automobile and bicycle parts, plumbing fixtures, tableware, door and window hardware, fine tools, boat fittings, and the like. In fact, there is no reason why a boy cannot earn extra money by doing plating for neighbors and neighborhood business concerns. The charger will then do double duty—keeping batteries in good shape and providing current for plating.



Diagrams showing the connections for electroplating and why the battery charger gives current suitable for plating

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HIGH-FLYING PLANES TO RACE SUN

(Continued from page 14)

closing an air-tight hatch behind him, and the machine continues its upward climb with compressors driving fresh air at sea level pressure into the cabin.

In the Junkers craft, the compressor is driven by a windmill outside the ship. Thus, independent of the engine, it continues functioning even if the motor stops. Another feature of this machine is a special apparatus that draws off carbon dioxide from the sealed cabin during a flight. All the stratosphere ships will carry reserve tanks of oxygen that can be turned on in an emergency if the compressors fail. Throughout the journey, the pressure and oxygen content of the air inside will be kept constant. To prevent air leaks, the moving control wires will leave the cabin through rubber openings and boxes of oil.

Because internal pressure will be far greater than external, at the peak of the climb, the cabins are specially reënforced to prevent them from exploding outward as a deep-sea fish bursts when brought to the surface.

For every mile a plane climbs into the air, until it reaches the stratosphere, the temperature drops about fifteen degrees. Throughout the stratosphere, the temperature is believed to remain constant at about seventy-five degrees below zero, Fahrenheit. Finding new alloys to stand this bitter cold was another problem the engineers had to solve. Ordinary hard metals become brittle and fragile at low temperatures and so are unsuited for use in the vital parts of a stratosphere ship.

PROVIDING heat for the cabins, however, automatically takes care of itself. The compressors turn at such speeds that the friction of the blades on the air heat it while it is being driven inside. At some altitudes, the air coming from the compressors is expected to be too hot and special radiators are provided to cool it.

All three of the machines will use four-bladed propellers of huge diameter to grip the thin air. The 430-horsepower inverted "V" engine on the sixty-one-foot Farman plane will turn a fifteen-foot forged-steel propeller with blades of variable pitch. As the machine mounts, the pilot can turn the blades to a greater angle so they will grip more air.

Supplying oxygen to the motors is almost as important as supplying it to the cabins. For the power developed depends upon it. Superchargers, forcing air into the cylinders under high pressure, will keep up the efficiency of the stratosphere engines in the rarefied atmosphere in which they will operate. The 800-horsepower motor on the low-wing, sixty-foot-span Junkers monoplane, and the eighteen-cylinder, 700-horsepower engine of Guerchais' craft, will both receive the compressed air from single superchargers. On the Farman plane, a battery of three smaller ones will go into action one after the other as the machine ascends. The first will begin work at 20,000 feet, the second at 30,000 feet, and the last at 48,000 feet. All three will be turning 25,000 revolutions a minute as the plane passes the 50,000-foot level.

IN A test tank at the Farman plant, the motor developed 300 horsepower when the air pressure and oxygen content were reduced to approximately those found at an altitude of 62,000 feet. The perfection of new superchargers is expected to lift the ceiling for thin-air planes to between 60,000 and 80,000 feet.

Not long ago, the Italian engineer, Italo Raffaelli, announced he has designed a steam turbine that will actually give more power as it ascends, thus making it ideal for use on the high-altitude air lines of the future. His engine weighs nine pounds per horsepower and uses naphtha for fuel.

Another suggestion for adding to the power of a plane at high levels has just been advanced by a German scientist. Since the drop in pressure between the exhaust gases and the surrounding air would be very great in the stratosphere, he points out, the engine might carry an exhaust-gas turbine to give extra power during such flights.

Long distance air raids by stratosphere planes are visioned as a feature of the next war. Military authorities, as well as air transport operators, are watching closely the tests under way. In fact, the French Air Ministry is actively coöperating with the Farman plant in the development of its machine.

Construction of the three planes now being groomed for the spectacular race to reach the stratosphere was begun soon after the Swiss scientist, Auguste Piccard, and a companion, in May, 1931, soared to a height of 51,775 feet in an air-tight aluminum ball slung beneath a balloon inflated with half a million cubic feet of lifting gas. Data collected by this Columbus of the upper air aided designers in their work. Early this spring, Piccard began preparations for his second voyage into the unknown for further observations.

THE highest point in the sky at which any record has been made is something over twenty miles, reached by small sounding balloons of the Weather Bureau. The record for airplanes—43,166 feet, set in 1931 by Lieut. Apollo Soucek of the U. S. Navy—falls more than a mile short of the lower fringes of the stratosphere.

Penetrating these upper reaches, where planes may some day race the sun around the earth, is the next important stride in flying. The trail-blazing machines of two nations, now tuned up in Europe, promise to lead the way to this new realm of travel.

USE BAKED POTATO IN REFINING GOLD

REFINING gold with a baked potato is the unusual method employed by some amateur gold hunters who, because of unemployment, are making a living by extracting small quantities of the precious metal from the sand of streams in the west. The specks of gold are first removed from the sand by amalgamating them with mercury. A small quantity of the amalgam is then placed in the heart of a large potato. After the potato has been baked until the mercury has evaporated, the ashes are panned for the pure gold. In larger quantities, the quicksilver is evaporated from the amalgam by using a retort kettle.

NEW MACHINE COUNTS TINY GRAINS OF SAND

A DEVICE that counts sand grains has been invented for the analysis of sediments by J. E. Appel, University of Chicago geologist. Fitting on the end of a suction hose, it is equipped with a thin brass plate containing 300 minute holes. Since the holes are smaller in diameter than the grains being counted, a single grain is attracted to each hole and is held there by suction. When every hole is holding a grain, the sand is carried off to a separate pile and another 300 grains picked up. In the past, the painfully slow process of counting has been done either with the naked eye or under a microscope. With the new device as many as 10,000 sand grains an hour may be counted.

HELP YOURSELF TO A HOME

(Continued from page 21)

weary of the city, so he wrote to the register of lands at Los Angeles asking where, in California, he could find land to homestead.

In reply the register sent him a list of all counties in California with the character of the lands set forth; level, grazing, desert, timbered, mountainous, agricultural.

He found in the envelope, also, a booklet entitled "Suggestions to Homesteaders and Persons Desiring to Make Homestead Entries," in which he found a paragraph informing him he first should pick out the land on which he desired to enter, then obtain from the land office a township plat showing what lands in that particular area were available. Having definitely located the plot, he again went on the land, prepared affidavits swearing he was acquainted with the land, that it was neither mineral nor saline, that he was capable of improving the land, that he was acting for himself and would in good faith make his home there.

Within six months he was required to make his home on the quarter-section selected, and thereafter to make his residence on the land in accordance with the rules.

OSBORNE didn't wait for six months to elapse, however. Within a week he had rolled his bedding and, with Mrs. Osborne, drove his automobile across the mountains to the site of his new home.

Slowly he cleared one corner of his tract. Meantime he built the two-room shack that today serves as home and store for he, too, found he had located on an occasionally-traveled desert "highway" and could cash in on the wants of his neighbors.

Uncle Sam told him he would be required to have crops growing on at least ten acres by the end of the second year, and on twenty acres in the third year. So down went a well a thousand feet west of his home, near a depression on the property, and there he grows his crops.

"The trouble with most homesteaders," Osborne told me recently, "lies not in the land but in themselves. The novelty of fighting with nature wears off, and some give up. If they only would come with moderate capital, a few hundred dollars, they would find they can make a go of it."

HOMESTEADERS can help guarantee their own success if they will bear in mind these simple but important rules:

1—Go on the land during the most unfavorable season of the year and study its characteristics.

2—Learn when and in what quantities rain falls.

3—Learn whether you are picking land in a frost belt and how cold the winters may be.

4—Talk to the natives of the neighborhood, particularly the old-timers, for they can tell you more about the land than Uncle Sam.

5—Above all, study the soil and water supply. In some regions state universities can supply helpful information.

6—Don't expect a big crop during your first year on the land, and be prepared to stick out the first seven months with plenty of food and a substantial tent or cabin.

Exactly what part of the remaining two hundred millions of acres are suitable for homesteading no one knows, not even Uncle Sam. Fifty million acres have not even been surveyed. You'll find 346,037,591 acres in Alaska; 51,399,000 acres in Nevada, which leads the other states in available acreage; 25,157,000 acres in Utah; 16,046,000 acres in California.

With the re- *(Continued on page 98)*

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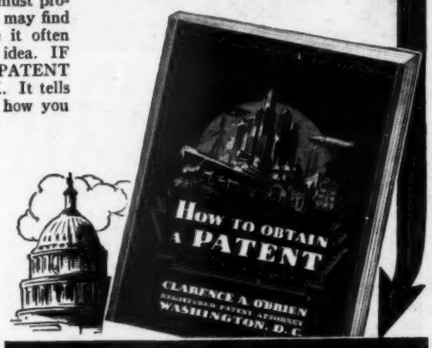

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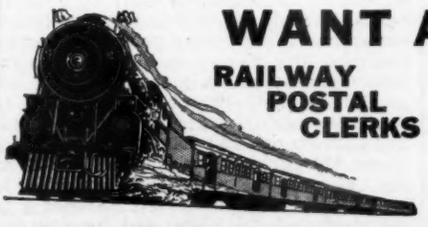

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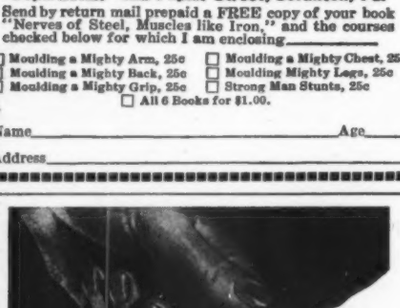

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HELP YOURSELF TO A HOME

(Continued from page 97)

cently increased demand for homestead acres, some people have shown a fine disregard for the rights of others. The most audacious attempt at stealing, or strong-arming land, has appeared in Los Angeles where more than 2,500 applications for homesteads on old Mexican land grants have been rejected by the land office.

The nearly 3,000 people who have literally demanded that Uncle Sam turn these valuable properties over to them disregard the ruling of the U. S. District Courts in California that these Mexican land grants, issued before the United States purchased California, are valid. Such was the clamor, in fact, that only recently Senator Bratton, on behalf of the Senate Committee on Public Lands and Surveys, reported that these old grants were legal and valid and that land-hungry applicants waste their time and money in trying to raid California cities and ranches, hoping to homestead tracts worth, in some instances, a hundred million dollars.

B-CURRENT FOR YOUR RADIO

(Continued from page 57)

of the B-supply portion of the transmitter.

Remember, the law requires that the B-supply of amateur transmitters shall be filtered direct current, and if the single two-microfarad condenser at C, which should have at least a thousand-volt rating, does not give sufficient filtering action, a filter choke coil and another condenser can be added as in Fig. 1.

Of course it is obvious that more power can be obtained from the B-supply of either Fig. 1 or Fig. 2 if a twelve-volt storage battery is used instead of a six-volt unit. In any case the current in amperes drawn from the battery will be many times the actual current obtainable from the secondary or B-supply.

The cost of building a power unit of either type will be quite low. Old spark coils can be bought for very little and 201A tubes or a gaseous rectifier tube are also low priced. If you prefer the buzzer interrupter circuit of Fig. 1, it should be possible to make the interrupter itself out of an old electric bell by rewinding with much heavier wire and fitting a long spring armature. If the armature vibrates too slowly, cut it off, a piece at a time, till you get the equivalent of sixty-cycle operation.

"PHON" IS UNIT USED IN MEASURING SOUND

LATEST among the words to join the vocabulary of science is "phon," a unit of sound devised at the Berlin Institute of Technology, in Germany. Research workers at the Institute are busy classifying sounds ranging from the yelp of a dog to the roar of a locomotive, according to their strength in phons. The trill of a nightingale, they found, has a strength of twenty phons; a spouting fountain, fifty phons; an automobile horn, ninety phons; and a motorcycle with the muffler cut out, 102 phons. All common noises, the experiments indicate, can be classified between one and 130 phons. Any noise above 130 phons causes pain in the ears of the auditor. The new unit is expected to prove valuable in providing a standard gage for classifying city noises and for referring to the strength of sounds in lawsuits.

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ROBBERIES ON A GIGANTIC SCALE

(Continued from page 47)

gers, but the judge failed to see the funny side.

At Morristown, N. J., a new $4,000 fire engine was purchased for the volunteer fire department. Three days later a small boy reported it missing from the fire hall. A frantic search discovered it in the woods, six miles away, and undamaged.

Celebrating July Fourth a couple of years ago, a Pennsylvania citizen espied a steaming locomotive. He knew nothing about driving locomotives, but he climbed into the cab, and a few minutes later had it on the main line. A modern safety device cut short his joy ride by tripping a lever and bringing the engine to a stop before it could wreck a speeding express. The celebrant got off with a fine of $50.

A HUMBLE "gob," late of Uncle Sam's Navy, beat this last example of absent-minded borrowing. Tired of life in the Philippines, this sailor climbed aboard the *Intrepid*, a yacht that was lying at anchor. Having considerable skill as engineer and navigator, the sailor headed for the nearest point in China, and was well on his way before the yacht was missed. Two roaring Navy seaplanes spotted the yacht steaming merrily along about sixteen miles out.

A similar affair brought a one-legged Minneapolis newsboy to grief. He was found in a bunk, half dead from seasickness, in the stolen yacht *Jaloma*, sixty miles out in the Atlantic! Arrested for grand larceny, he told an apparently straightforward tale of being persuaded to go for a trip to see yacht races off Newport, the goodlooking stranger failing to mention that he was stealing the yacht. The latter, after lashing the wheel and setting all sails, had deserted his seasick passenger and set off for shore in a tender. He may have been lost at sea, as a thick fog enveloped the region; and the yacht, sailing in circles, was nearly run down by a fishing trawler.

More disastrous was the yacht-stealing case of Frank Pollo, who stole a yacht in New York. No one knew where it had gone, and it was a great mystery until found wrecked on an island off the north coast of Holland, last October. The man, found dead, apparently had made the transatlantic crossing alone in the motored sailing yacht. Overtaken by a storm, he probably had been driven ashore.

ALL these instances of mass production in thievery fade into insignificance before the exploits of European masters, who do not depend entirely on their own efforts. In one small country, a firm was employed to build a tunnel, in territory formerly Austrian. For seven years regular reports showed the progress of the tunnel, men employed, material removed, and so on. The government paid the contract price, and at the grand opening officials found a few workmen cleaning up the débris. The tunnel was there and the contractors were congratulated.

An engineer, celebrating too boisterously the completion of his arduous task, proved the undoing of these "contractors." He revealed that the tunnel had been dug six years previously by Austrian and German troops, who had abandoned it when the war front shifted. The firm had received five and a half million dollars for digging a hole in the ground that already existed!

If that seems incredible, what of the discovery announced a few years ago by the Prime Minister of Rumania? He reported that an entire railroad—rails, ties, switches, spikes, even rolling stock and signal system—had completely disappeared! Constructed in wartime, from Cluj, Transylvania, to Jacobeni, Rumania, it was said to have cost almost four million dollars. Apparently it had been dismantled piecemeal and the parts sold without exciting suspicion.

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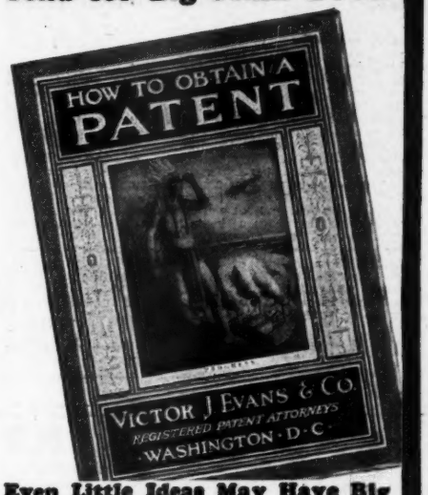

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CAR'S AMMETER CAN WARN OF IGNITION TROUBLE

(Continued from page 60)

thing that keeps it from burning up is the fact that it only has to run for a few seconds at a time.

"Now the generator is a different proposition. It's on the job as long as the engine is running above idling speed. So it's designed to produce not over eighteen or twenty amperes and it keeps the battery charged only because it runs a lot longer than the starter motor. If you tried to make a regular size generator produce more current than about twenty amperes, it would soon burn out.

"Mechanically, too, there are differences. The bearings on a starter motor are pretty crude because they don't have to stand steady running. Generator bearings, being made for continuous use, are much more durable.

"The copper brushes needed to cut down the resistance and let lots of current through the self starter motor windings are not nearly as good for steady use as the graphite carbon brushes used on the generator."

"THAT reminds me," Dilbow cut in. "The self starter on my old car doesn't always work. Sometimes when I step on the pedal it turns the motor over in a sort of a rough, bumpy way. The next time, it won't stir at all. What's the matter?"

"Turn on the headlights and watch the ammeter when you step on the starter," Gus advised. "If the starter takes hold and the needle flickers to beat the band or the starter doesn't work at all and the needle stays still, probably the self-starter commutator is worn and burned so badly the brushes only make contact part of the time.

"There are other things the ammeter needle tells you about your electrical system," Gus went on. "It shows you whether or not the generator cut-out is working, besides telling you when the generator is on the job. It tells when one headlight burns out by the difference in the needle position. It shows you what happens when you move the third brush and how much to move it to get the result you want. If the motor suddenly cuts out when you're breezing along, a quick glance at the ammeter will tell you whether to look for a break in the primary ignition wiring, something gone wrong with the breaker points, a burned out condenser, or a shorted distributor head."

"How do you tell that?" Dilbow asked.

"SIMPLE enough," Gus explained. "When the ignition system is working, it takes current and the needle shows on the discharge side. If the primary circuit is open or the breaker points have backed away so they don't touch or they're burned so badly they don't let any current through, the needle goes right back to zero. If the needle acts as usual, you can be sure that the contacts are working and the trouble must be in the condenser, the high tension winding of the coil, the high tension wire from the coil to the distributor, or the distributor head.

"See how this all brings you right back to this new invention of yours," Gus added, fingering the drawing. "You'd never have wasted any time on this idea if you'd figured out what the ammeter shows. It's really like a gage you could put on a water pipe to show you how much water is flowing."

"I get you," Dilbow observed. "The starter motor uses electricity by the bucketful for just a few seconds and the generator puts it back, a spoonful at a time, and the only reason it works at all is because the generator is on the job all the time."

Slowly he tore the brown paper plan into long, thin strips. "I guess I won't waste any more time trying to get something for nothing!" he decided.

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OUT OF THE AIR ON A BAG OF SILK

(Continued from page 37)

of the watch and when the excitement ended the hero of the day was the pilot parachute.

A week after New Year's in 1924, I was flying a "Jenny" biplane, with an OX motor, east of Indianapolis, Ind. Heavy snow clouds were piled low in the sky. At frequent intervals drifting fingers of fog hung down.

About 4:30 it began to grow dusky. I was flying wide open, trying to make Dayton, Ohio, before dark. East of Knightstown, the fog fingers became more frequent. I had burst through three in rapid succession and was coming out of the fourth when the ship suddenly seemed to strike a stone wall in the air. I was catapulted against the instrument panel. There was a ripping crash. The plane trembled all over, reared skyward, and then began to fall.

Another barnstormer, racing toward Indianapolis, had crashed into my ship without seeing me. Flying a few feet above me, his landing gear had struck my upper wing head-on, smashing it back over the cockpit like a lid on a pot, pinning me in.

I FOUGHT to push the wing away and jump. It was tipped up at a steep angle and the pressure of the wind glued it in place. A giant couldn't have budged it. The opening between the wing and the front of the cockpit was too narrow to worm through. All this time, the ship was falling.

I kicked through the canvas side of the fuselage and tried to wiggle out backward under the inverted V of the crossed bracing wires. The space was just too small. One wire leg of the inverted V pressed against the back of my scalp, the other dug into the back of my ankles. Doubled up like a jackknife, I struggled to squirm free, but I was jammed fast.

The seat-type parachute I was wearing was outside the fuselage. I took a last desperate chance. Pushing over the rudder bar with my hand, so the ship sideslipped violently away, I jerked the rip cord. The silk, trailing after the pilot 'chute, streamed away from the plane. It popped me out the opening, scraping chunks of skin from the back of my heels and scalp, but pulling me free.

It seemed only a second before I landed hard on a snow-covered field beside the railroad, where the other flyer scraped to a safe landing on the bottom of his fuselage. I had broken out of the ship at less than 600 feet. Although I was jolted and sore for a week afterwards, I had escaped, thanks to the quick opening of the silk, dragged out by the pilot 'chute.

THAT was the lowest jump I ever made. "The higher, the safer," is an old saying among professional parachute men. In exhibition drops, they rarely dive off a plane below 2,000 feet. Then, if anything happens they have time to work the 'chute open before they hit. Once a veteran said to me: "Never quit fighting a parachute if it doesn't open right away."

I remembered that bit of advice later on during an air circus in northern New York. At 2,000 feet, I dropped from a wing and reached for the rip cord ring, located on the left side of my harness. I jerked but the ring didn't budge. I tugged harder. Still it stuck. I had to give four violent tugs and finally use both hands before I could open the 'chute. I plunged nearly 900 feet before it was open.

In a long fall, a jumper tenses the muscles of his chest and shoulders just as the 'chute opens to take the shock of the sudden jerk in slowing down. Most people think a parachute opens like an umbrella. As a matter of fact, moving *(Continued on page 102)*

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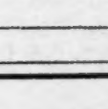

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OUT OF THE AIR ON A BAG OF SILK

(Continued from page 101)

pictures of 'chutes opening in the air show that they fill at the center first, the edges spreading out last of all. Thus, they begin to slow down before the whole expanse of silk is open. When a jumper is upside down in the air as he jerks the ring, this initial slowing down turns him right side up before the big jerk comes. Otherwise, the sudden snap might break his neck. Incidentally, it is a wise thing to keep your teeth set until the parachute is open, otherwise the jerk may make you bite your tongue.

Dan Smith, the famous Army jumper who made more than 1,500 parachute drops from planes, used to take 300-foot swan-dives into space from the wings of my ship at Rochester, N. Y. At the time he was doing parachute work for the Reynolds Airways. His favorite method of taking off was to make a cartwheel from the wing, spinning head over heels until he jerked the rip cord.

During one of his first jumps in the Army, Smith had a breath-taking escape when he fell through the tail of a De Havilland biplane. He was crawling out on the wing for a jump when he slipped and fell. At the same instant, for some unknown reason, the pilot pulled up the nose of the ship into a climb, dropping the tail. Smith crashed into it, breaking his nose and bruising himself in a dozen places. Only half conscious, he clung to the streamlined bracing wires until they cut his hands to the bone. When he was sure his parachute was not hung up anywhere, he dropped from the tail, jerked the ring, and made a safe landing.

BECAUSE a parachute streams up seventy feet or more when the pack is opened, the jumper must wait until he is more than that distance below the plane before he jerks the rip cord. Usually beginners are told to count three slowly before they reach for the ring. If the parachute is opened too soon, it is likely to foul on the tail of the plane and tear.

Army airmen making their first jumps are given two 'chutes and carry a knife in a special pocket attached to the harness. Then if one parachute fouls, they can cut the shroud lines and descend safely with the second. Another recent requirement is that service men make at least one jump with a parachute which they have packed themselves.

Sometimes, in exhibition leaps, men come down with two or more 'chutes open. I remember once last summer, Joe Crane, the famous jumper at Roosevelt Field, L. I., drifted down with four open at once. In such a jump, no two rip cords are pulled at the same time. Each 'chute is opened separately to prevent fouling.

WHEN a jumper is carried out over a lake or river, he should swim as far as possible underwater in the direction from which the wind is blowing before coming to the surface. If he comes up under the parachute, there is danger of becoming tangled in the shroud lines and drowning. Dan Smith used to unbuckle his harness, hang by the arm loops and then, when within fifteen feet of the water, make a high dive into it, letting the 'chute come down by itself. Ironically enough, it was in water that Smith met his death. He is believed to have been attacked by cramps when he landed in the swirling currents of the Delaware River, during a jump at Port Jervis, N. Y., last year.

At least 100 times I have piloted ships from which parachute jumpers took off. Of all these jumps, probably the queerest was made at Roosevelt Field by Buddy Bushmeyer dressed in a huge white Easter rabbit suit, with ears a yard long. We picked a spot for the jump that would take him right over the grandstand at Roosevelt Field and he had the time of his life wiggling his ears at the children in the audience as he sailed overhead.

In spot landing contests at air meets, jumpers leap from an altitude of 1,500 feet to see which one can land nearest the center of a 400-foot circle. Some start almost over the circle and make a delayed drop, falling 800 or 1,000 feet before pulling the ring. This gives the wind less time to drift them away from the mark. Others start farther from the mark, open their parachutes as soon as they are clear of the ship, and try to maneuver into the circle during the long descent.

This is done by steering or "slipping" the 'chute by pulling down on the lines on the side toward which you want to move. For every 100 feet you descend, you can slip your 'chute ten or more feet horizontally in any desired direction. Sometimes, when a jumper is landing in a strong wind, he slips his parachute into the wind just before he touches ground. This reduces the speed at which he strikes and lessens the chances of injury.

ONE of the best bits of parachute maneuvering I remember was performed last year by Joe Crane. He placed a friend near the center of Roosevelt Field and then came down from 2,500 feet steering his silk umbrella so accurately that, if his friend had not moved, he would have planted his feet on his shoulders.

The most thrilling jump I ever experienced was when I joined the Caterpillar Club officially over Georgia in the crash of the ill-fated "K," two years ago. In this big snow-white monoplane, I left Roosevelt Field, L. I., with two companions, Jimmy Garrigan and Garland Peed, in an attempt to fly non-stop from New York to Buenos Aires, Argentina.

We took off at dusk. Heading south we ran into rain and mist, then struck fog. For more than eight hours, we flew blind, battling through air as thick as cotton batting. At three o'clock in the morning, the left wing began to drag. Then a long ominous crack, splitting the ceiling of the cabin, appeared over our heads. The doomed ship was pulling apart. There was only one thing to do—jump.

Garrigan went first, at 5,000 feet. Peed and I bailed out next, leaving the ship at 2,500 feet. I tried to get out the cabin door. The strain on the fuselage had twisted it, jamming the door tight. I couldn't budge it. I kicked a hole in the window of the fuselage and wiggled through. The wind caught me, whirled me around, crashed me against one of the steel wing struts. Then, I dropped into the thick fog.

WHEN clear of the falling plane, I tried to reach across with my right hand to jerk the ring. I couldn't move my arm. The force of striking the strut had dislocated my shoulder. While I ripped downward through hundreds of feet of fog, I struggled to hook the thumb of my left hand through the ring. When I got it in, I pushed the ring across my chest and the parachute popped into full bloom, just in time.

At present, only Army and Navy flying schools require students to make parachute jumps as part of their training. Some day, I believe all flying schools will include such descents as part of the work toward a pilot's license. Knowing how to handle a parachute and make a jump is as important to an airman as knowing how to swim is to a sailor.

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A. F. GRIDLEY,
Sarasota, Fla.

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I am very much satisfied in every way with my Midwest radio. I heard Sydney, Sunday 3:00 A.M. Also W8XK; W3XAL; WIXAZ; W2XAF; in the evening. On the regular band have some 55 stations so far.
Aug. Balbi, 1427 Myra Ave.,
Los Angeles, Calif.

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Cincinnati, Ohio.

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MIDWEST RADIO CORP.

DEPT. 121 **(Est. 1920)** **CINCINNATI, OHIO.**

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS

How Jungle Beasts Live Near Big Cities

(Continued from page 27)

drinks water, the corn swells, and digestive disturbances result.

When evening comes after a busy day, if all the animals are still safe and sound, the keepers heave a sigh of relief. But they can never be sure until they check up. Not long ago, after the day's excitement had died down at the elephant house, the New York keepers heard "Peter the Great" making strange hiccoughing sounds in his pen outside. They rushed out just in time to pull a pop bottle from the hippo's throat and prevent it from choking to death!

Special precautions are taken to keep meat-eating animals from choking on their food. Every piece of horse meat or beef that is tossed into a cage has a bone in it. If solid meat were given the big cats, I was told, they would swallow the chunks whole and strangle. By having to tear the meat from the bones, they get it in small shreds.

At night, when the bear dens are silent and the monkey house has quieted down, activity begins in the reptile house. Feeding starts about eight o'clock. Rabbits, rats, guinea pigs, frogs, tadpoles, day-old chicks and occasionally a young pig are on the menu. Every ten days, the Regal pythons feast on ten chickens or a small pig. For three or four months they eat regularly. Then they rest for a month. One captive python from the Island of Borneo, Raymond L. Ditmars, curator of reptiles and mammals, told me, quit eating for twenty-two months.

ONCE a week, the king cobra dines on a plump five-foot gopher snake. This cobra refuses to eat anything but snakes, so a man in Texas has a standing order for approximately 250 feet of gopher snakes a year to feed it. They are shipped north twelve at a time and cost $1.50 apiece. The main food of the other snakes is mice and rats and for them, too, the dinner bell rings once in seven days.

In the daytime, when most of the snakes are sleeping, the lizards and turtles that live in the reptile house have their meals. The showy little green lizards gobble down mealworms; the iguanas nibble bananas; the monitors swallow fresh eggs whole without breaking the shells; and, three times a week, the 300-pound Galapagos tortoise packs away fifty bananas or ten heads of lettuce or two dozen tomatoes at a sitting.

A bird house alone requires a wider variety of foodstuffs than the Waldorf-Astoria. The bill of fare ranges from horse meat to thistle seeds and includes cottage cheese, ant eggs, zwieback, chickweed, raisins, milk powder, cabbage, honey, and dried flies! "Mealworm ranches" at New York produce half a million wiry little worms a year for the birds. Special mills roll and crack grain and an extensive nursery raises chickweed and other greens. At the Washington, D. C., park, special fly-farms, consisting of wire-mesh boxes, turn out flies for the lizards and birds.

RECENTLY, a ruby-throated humming bird set a new record by living three years and four months in captivity at Bronx Park. The previous mark, established at a western zoo, was two years and a half. In place of the natural food of these little birds, the nectar of flowers, they are fed on a mixture of barley water, honey, condensed milk, and a prepared baby food.

One of the problems of feeding that requires much research and experimenting is finding substitutes for the natural fare of rare specimens. For instance, ant eaters are no longer fed ants in the zoo. They get milk into which is stirred eggs, oatmeal and finely-scraped beef. This diet, developed at Bronx Park after four years of research, supplies the needs of this strange animal and has been widely adopted at other zoos throughout the country.

The total food bill at New York runs to more than $45,000 a year, that at Philadelphia approximately the same, and that at Washington upwards of $30,000. On the New York list you find such items as: $5,000 for horse meat, $3,000 for bananas, $9,000 for hay and $1,100 for bread. Among the smaller purchases there are: 384 live sparrows, 770 pounds of cottage cheese, 24 boxes of huckleberries, 45 pounds of peanuts, 810 live frogs, 21 pounds of prunes, 279 pounds of cake, and 500 pounds of weed seeds.

Special hospitals equipped with operating rooms, isolation wards, diet kitchens, research and diagnosis laboratories, and mortuaries are part of the equipment of many parks. Here cuts and scratches are dosed with iodine, X-rays made, broken legs set in splints, teeth examined, and operations performed while the animals are under the influence of ether or local anesthetic.

Cash Prizes for PHOTOGRAPHS

IN NEXT month's issue begins a novel and interesting cash prize contest open to amateur photographers. Anyone may compete, for the rules of the contest give either beginner or expert an equal chance to win a prize. Full details will be published in the November issue, on sale October 1.

NEARLY fifty drugs and remedies are used at the New York park's animal hospital, including cascara tablets, mustard plasters, cough syrup, Epsom salts, and half a dozen antiseptics. Every new arrival at the zoo is kept under observation for two weeks to be sure it has no contagious disease or unusual parasites. One research man spends his time studying and classifying parasites. Last year, he discovered a hitherto-unknown type of round worm in a Branick rat.

When deer in one western park became troubled with internal parasites, not long ago, it was found the worms were entering their bodies by way of june-bug eggs which they were eating with grass in the pasture. The deer were switched to hay and the pasture was burned over with blowtorches to destroy the eggs.

One job a zoo doctor has on his regular schedule is clipping the claws of the lions, tigers, and bears. A special cage, equipped with a side that slips over and holds the animal quiet while the work is going on, runs along a track in the basement of the lion house. Recently, Dr. Charles V. Noback, Bronx Zoo veterinarian, administered a dose of the gland extract, pituitrin, to a lioness to aid her in giving birth to cubs. While pituitrin has been used in treating humans at childbirth, this was the first time in history it had been given to animals.

WHENEVER an animal dies at a park, its cage is thoroughly disinfected and a post-mortem examination performed to determine the cause of death. Such an examination, last year, revealed that the world's biggest captive elephant, "Khartoum," had died of heart trouble.

Weighing 10,000 pounds, this twenty-eight-year-old African giant was the most destructive animal ever kept at Bronx park. A special door that weighed a ton and a half and worked with a worm screw had to be fitted to his cage as he would tear an ordinary door from its hangers.

IN THE summer of 1922, the rarest specimen ever brought to an American zoo died after being on exhibition forty-nine days. It was a duck-billed platypus, a strange egg-laying mammal that had been brought 10,000 miles from Australia to New York.

The duck-bill ate only shrimps, white grubs, and angleworms. In a single day, it would consume half a pound of angleworms, forty shrimps, and as many grubs. The cost of feeding the eighteen-inch animal, the only one to be brought alive from Australia, was approximately $5 a day. Because of its nervous temperament, it could be exhibited only one hour a day and visitors, in line, approached its tank in perfect silence.

Twenty-five hundred dollars, or approximately $500 a pound, was paid for the duck-bill. That set a record for costly specimens. While "Mogul" is valued at $25,000, this rhinoceros weighs as much as a small switch-engine and so costs little per pound of rhino. "Jimmy" the shoebill "stork," costing the New York park $1,400, holds high place among the birds for costliness.

At present, if you want a pair of Royal Bengal tigers, they will cost you $5,000. Siberian tigers run as high as $10,000 a pair. Jaguars come at $500, leopards at from $200 to $300, lions at $2,000 a pair. A half-grown Baird's tapir costs $500, polar bear cubs, a year old, $400; grizzly bear cubs, eight months old, $300. Zebras sell for from $1,000 to $2,000 apiece. A two-year-old female African rhinoceros, forty-one inches high, has a market value of $4,800, while an Indian rhino runs as high as $7,000. Monkeys range all the way from $15 to $500, according to their species; baboons from $100 to $300, chimpanzees from $500 to $900. Young gorillas sell for $4,000 apiece. There aren't any old gorillas as they never live long in captivity. When "N'gi" died last winter in Washington, despite efforts to save his life by administering oxygen, he was five years old and had lived longer than any other gorilla had ever lived in captivity in the U. S. A mandrill in full color will bring $500 and a pygmy hippopotamus from $3,000 to $3,500.

Pythons come at so much a foot. A twenty-five-foot snake of this kind will cost $1,000, or $40 a foot. Cobras have a flat price of five British pounds, or $25. King cobras, twelve feet long, fetch from $150 to $200. The rare blood python is priced at $2,500. Rattlesnakes range from $5 to $8 with big eight-foot rattlers going as high as $15. Emerald tree boas, "the birds of paradise of the snake house," sell for $75, and the average small snake in a collection costs from $5 to $10. The price of lizards runs from fifty cents for little ones to $75 for the six-foot monitors and $500 for the rare Komodo Island "dragons," ten feet long.

ANIMALS come to a zoo in three ways. Most of them are bought directly from animal traders who either capture them in the field or buy them from native hunters. Others are donated by explorers who bring them back to civilization on their return from distant countries. And a few come in exchange for other specimens.